2/6 NEW ZEALAND AUCKLAND 1931

RADIO HANDBOOK ANNUAL

RADIO

NUMBER 2. MARCH, 1931.

World's Wireless Progress in 1930

Modern Broadcasting Methods — Empire Broadcasts — Wireless Telephony — Wellington Station — The Connecting Link — Whence the Messages Come — Further Developments

The Supplying of a Broadcasting Service

A.C. Apparatus

Small Mains Transformers — Audio-Frequency Chokes — A.C. Power Pack — Grid Bias Eliminator, Etc.

Receiving Sets

Two Valve Battery Set — Short Wave Receiver — Band Pass Tuner and One Valve Battery Set — Band Pass Three — A.C. Screen Grid Four — Screen Grid Booster

Amateur Transmitters' Section

Amateur Transmission — The Q Code — "Ham" Abbreviations — List of N.Z. Amateur Transmitters

Battery Charging — Amplifiers — Eliminators

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REPRODUCING *a nation's entertainment*

The greatest tribute ever paid to any product of the radio industry. . . . Reproducing a nation's entertainment. . . . Approval voiced so effectively by leading engineers and critics that **Jensen** *-Dynamic Speakers are now more widely used than ever before. At the Atlantic City R. M. A. Trade Show more radio receivers were equipped with Jensen Speakers than with any other make. These receivers are destined to be the season's best sellers for they will offer the finest possible tone quality. To the manufacturers of these receivers the cost of the speaker has been secondary. . . . Designers and engineers of talking moving picture, public address and allied apparatus have also voiced their approval, particularly of the new Jensen Auditorium, with 12 inch cone, and Auditorium, Jr., with 10 inch cone, Speakers. . . . The new model D8 Jensen Concert Speaker, with 10 inch cone, has been designed particularly for use in radio receivers. . . . All of these new reproducers represent the culmination of Peter L. Jensen's genius and twenty years of experience. All are available for either AC or DC operation from any convenient source of power supply.*

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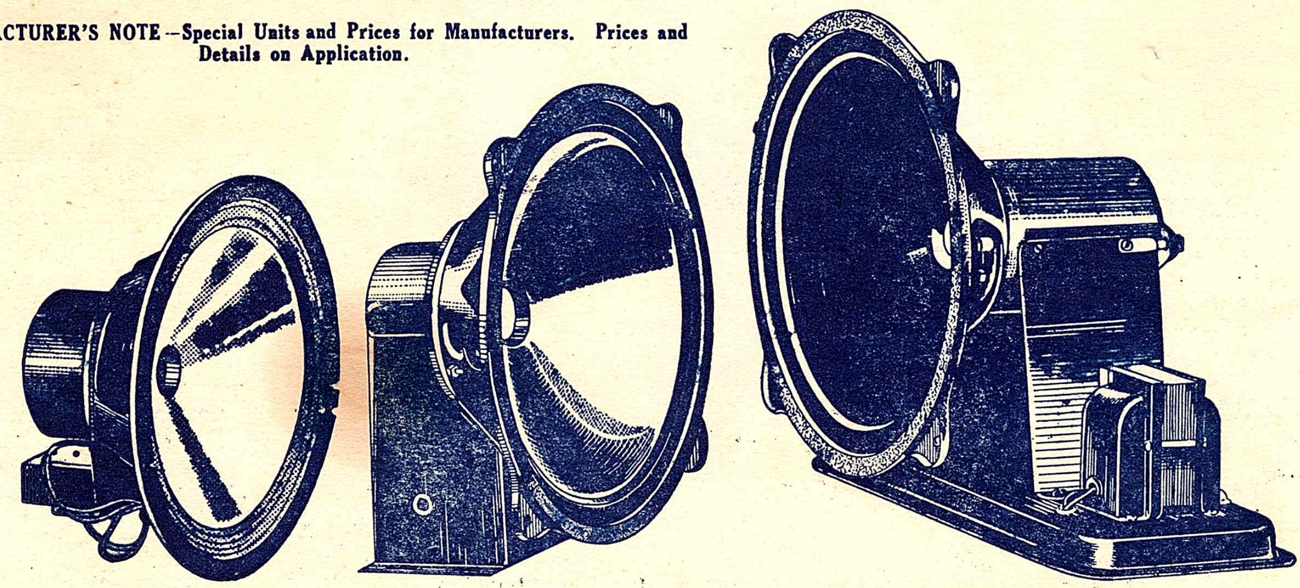
MANUFACTURER'S NOTE—Special Units and Prices for Manufacturers. Prices and Details on Application.



MODELS D10 & D11
7¾in. Cone. Prices from £4

MODEL D8
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AUDITORIUM SENIOR MODEL
12in Cone for Theatres and where great volume is required. From £12/10/-

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DYNAMIC SPEAKERS

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The STAR of all VALVES

That irritating wait for your valves to heat

IS ELIMINATED by using

ARCTURUS

Seven Second Valves

They are in action in ONE QUARTER of the time taken by the ordinary valve. Yet they give HUMLESS RECEPTION and LONGER LIFE.

Your Receiver will give you better results and you will secure more hours of satisfactory service if you use the—

ARCTURUS BLUE VALVE

A.C. and Battery Types

If you are not ready to replace your whole team of valves, try an ARCTURUS DETECTOR now, and the result will astound you.

PRICES:

126	(226 type)	Amplifier - - -	12/-	180	(280 type)	Full Wave Rectifier -	15/-
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145	(245 type)	New Power Amplifier	16/-	124	(224 type)	Latest Screened Grid	24/-

When Next Purchasing Your A.C. or Battery Valves—
Demand ARCTURUS the 'Quick Action' Blue Long Life Valve

STOCKED BY ALL GOOD RADIO DEALERS

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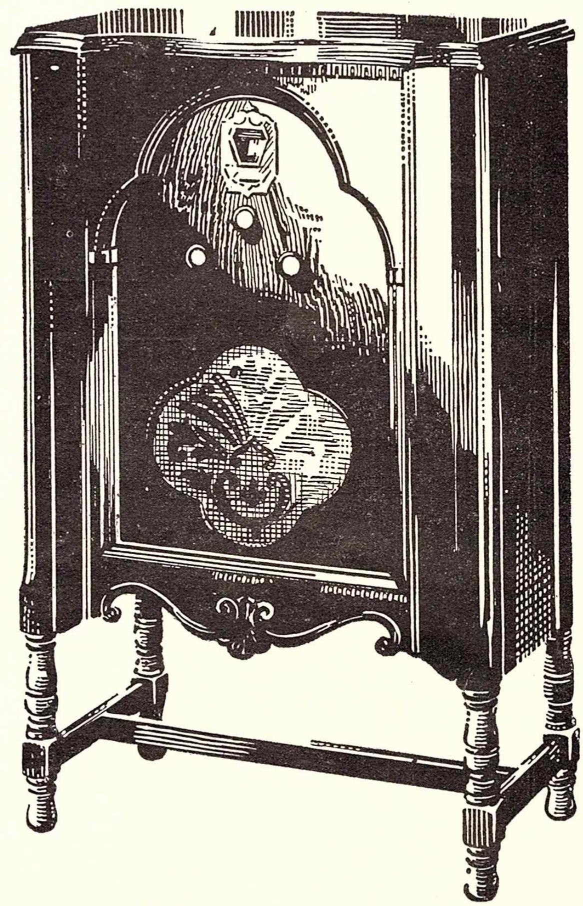
ADVERTISERS INDEX

Clarion ELECTRIC RADIO

Clarion Radio

... the greatest Radio value at any price



In richness and fidelity of tone, in clear powerful rendering of distant stations, in clean-cut selectivity—in all that makes for complete radio enjoyment — CLARION out-performs receivers of several times its price.

.... Check CLARION against any receiver in the world—you will find in CLARION a richer tone, fuller, more faithful and absolutely humless.

.... You will find CLARION an instrument of unusual beauty—cabinets of fine matched woods, gracefully designed by master craftsmen—rich enough to fit any home.

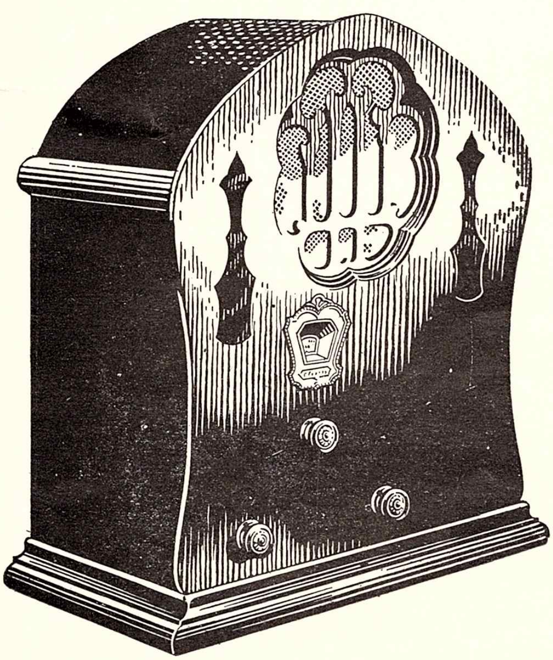
.... Test CLARION'S Selectivity—there's no spilling over from adjacent channels.

.... Try it for distance—CLARION picks up the faintest signals and Amplifies them to sonorous volume--brings you over long distances true recreation against background of silence---a delight to the most rabid DX fan.

MODEL A.C-51—An unusually attractive model of matched swirl walnut and satinwood 40 inches high, 26½ inches wide and 14½ inches deep—a full sized cabinet, yet not too large for the smaller rooms. Standard Clarion chassis. Local-distance switch. Electro-dynamic speaker. **£48**

Also procurable in HIGHBOY MODEL 53 and COMBINATION GRAMOPHONE & RADIO MODEL 55, a glorious instrument

Clarion Radio



CLARION JUNIOR has been developed to meet the modern demand for radio convenience while retaining big-radio tone, selectivity and sensitivity. **£27/10/-**

Stocked throughout N.Z. by Main Offices and Branches of

The Bristol

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here is also a Clarion Distributor for every other part of New Zealand

New Zealand Radio
Handbook Annual

The Radio Cyclopaedia

Editor: GEORGE CLARKE

Technical Editor:
G. McB. SALT, M.Sc.

Associate Technical Editors:
R. J. ORBELL, B.E., A.A.I.E.E.
H. P. V. BROWN, (ZL3CG)

March, 1931

PUBLISHED BY
H. G. FARNALL & CO. LTD.
AUCKLAND
1931

Build Your Own Radio

¶ *Not, however, by buying odd goods here and there and following vague instructional information - - -*

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Remove all doubts in building---every part is perfectly matched to run efficiently with others---Every part is accurately placed to give the finest results---Every wire, every screw, must go to its correct position. In fact, so precise are the diagrams and instructions that you can often build BETTER THAN MOST FACTORIES. Yet the designing, preparation of diagrams etc., cost you nothing---you merely pay for the parts.

Auckland's Oldest Radio Firm. EST 1920 JOHNS LTD CHANCERY ST AUCKLAND

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	Valves
Ace - - - -	1 to 3
Hammarlund Roberts -	4 or 5
Screened Grid (Short Wave and Broadcast) -	4
Meniwave Sets - -	1 to 3
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Send for List

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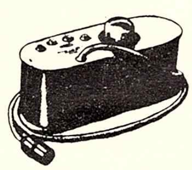
Lead the World!



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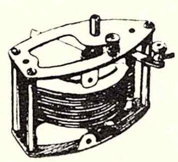
D.C. 200-250 volts popular model £2/2/-
D.C. 200-250 volts model B - £3
A.C. 230 volts popular model £4/5/-
A.C. 230 volts model B £5/10/-



VARIABLE CONDENSERS

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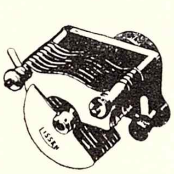
.0002	9/-
.0003	9/-
.00035	9/6
.0005	10/-



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(Complete with Knob)

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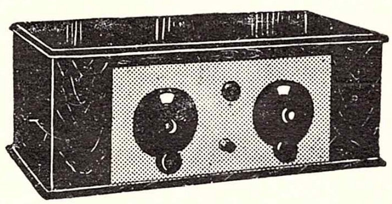


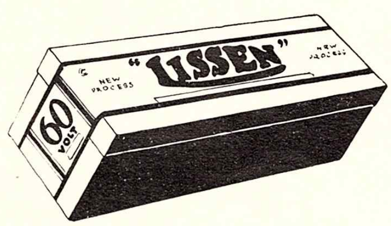
SCREEN-GRID "3"

Kit Set—brings in all Australian and N.Z. Broadcast Stations. Price of Kit, £6, or complete with valves, batteries and loudspeaker, £13/12/-

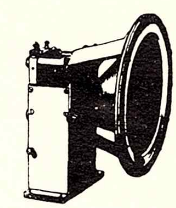
Short-wave Coils 20/- extra

FIXED CONDENSERS

.0001 to .00025 mfd.	1/6
001 and .002 ,, ...	2/-
By-Pass .01 mfd. ..	2/6
,, .1 ,, ..	2/9
,, .25 ,, ..	3/-
,, .5 ,, ..	3/3
,, 1 ,, ..	3/9
,, 2 ,, ..	4/9
,, 4 ,, ..	8/3

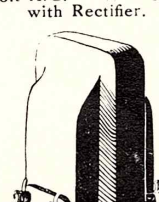


LISSEN BATTERIES
60 volt B. or H.T. 14/- 100 volt B. or H.T. 24/-
9 volt C. or G.B. 3/-
Wander Plugs for Batteries, 4d. each



LISSEN LOUDSPEAKERS
4 Pole Balanced Armature Units Adjustable 25/-
Above complete with aluminium chassis and cone .. £2/5/-

LISSEN DYNAMIC LOUD-SPEAKER CHASSIS
Moving Coil, Permanent Magnet £8/15/-
230 volt D.C. .. £5/10/-
230 volt A.C. .. £8/10/-
with Rectifier.



LISSEN TRANSFORMERS
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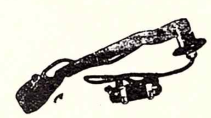
Standard 13/6, Super 25/-



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with moulded trackarm .. £3
POPULAR MODEL PICK-UP
Price 25/-

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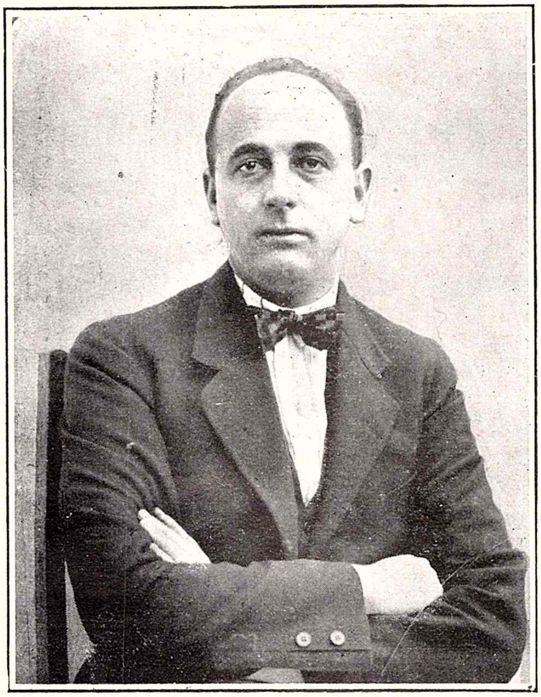


G. McB. SALT,

M.Sc.

Technical Editor, Broadcasts

OUR CONSTRUCTIONAL FEATURES

IN the articles describing the apparatus for amateur construction, the 1931 Handbook Annual features power units and receiving sets for operation on A.C. mains. Some features of design in sets may change from year to year, but the basic factors influencing the design of power units are invariable. Because of this, the detailed descriptions of the design and construction of power units for mains operation will not be repeated in future issue of the journal. In any case demands on space prevent repetition of articles and tables from year to year, no matter what their importance. Listeners who wish to keep contact with progress in modern design should therefore make it a practice not only to procure a copy of each Handbook Annual as it appears but also to keep it readily accessible for reference purposes.

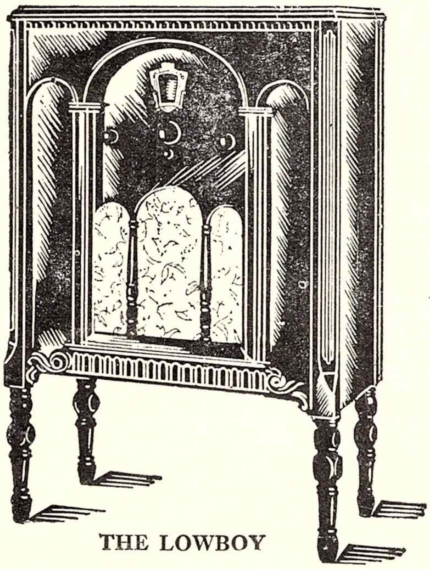
The all-mains set is the set of to-day and the future, however the actual circuit arrangements may change. Accordingly the owner of even the humblest battery or even crystal set would do well to read up the A.C. section of this magazine.

The object of the constructional section is to keep amateur constructors in touch with the latest developments in receiving sets such as are capable of being built in the home even where the workshop equipment is limited. Elaborate sets which can be built and made to work satisfactorily by the individual who is a combination of expert electrician, wood and metal worker, find no place in this publication. The sets are graded from the point of view of ease of construction and operation and, as far as is practicable, an endeavour has been made to use components in the simple sets which will be found of use when experience has made it possible to attempt the building of a more complicated set.

G. McB. S.

Presenting Radio's Newest Miracle——

PHILCO Tone-Control



THE LOWBOY

Philco Screen Grid Lowboy, with Philco Tone Control. A truly beautiful set. Electro-dynamic Speaker. Balanced unit construction. Exclusive Clear-vision Station Register and Dial. PRICE £48

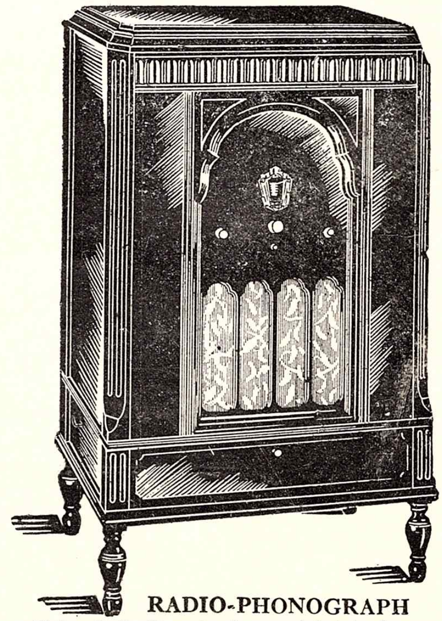
BRILLIANT
BRIGHT
MELLOW
DEEP

4 shades of tone value with Philco Tone Control. Now with your own hand you can reach out and with a knob on the front of the receiver instantly change the tones of Radio stations and programmes to suit your tastes and moods—BRILLIANT, BRIGHT, MELLOW, DEEP—whichever you prefer.

AND FINALLY, for Radio stations which come in harshly in your locality, or marred by interference, you can subdue the noise and enjoy many additional fine programmes.

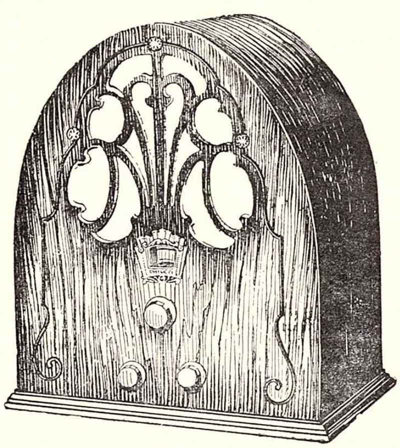
All of these great features are retained and Philco Tone Control is added. Philco's new Radio's are all you can buy in Radio no matter what you pay. The Philco Screen Grid Plus has, in addition, AUTOMATIC VOLUME CONTROL which counteracts fading.

This is a special feature of the new Philco Radio, designed so that you can not only get, but hold and enjoy, programmes of a varied selection.



RADIO-PHONOGRAPH

Philco Radio-Phonograph, containing the famous Screen Grid Plus Radio with Philco Tone Control in combination with Philco's Newly-designed Phonograph equipment. Balanced unit construction, magnificent cabinet. Price £85



PHILCO BABY GRAND

Is a balanced-unit Set—Philco's exclusive method of balancing all electrical units to give full, rich, true tone without distortion. The built-in speaker is genuine electro-dynamic. PRICE £26-10-0

AGENTS WANTED IN ALL TOWNS WHERE "PHILCO" IS NOT ALREADY REPRESENTED.

Arrange a Free Demonstration in the quiet of your own home, and judge for yourself, or call on us for all particulars

Sole New Zealand Agents:

"Beggs"

CHAS. BEGG & CO. LTD.

Auckland, Wellington, Christchurch, Dunedin, Invercargill, Nelson, Timaru, Oamaru

List of Radio Stations
which may be heard in N.Z.

NEW ZEALAND BROADCAST STATIONS

"A" Class Stations

Call Letters — Station — Metres

1YA—R.B.C., Auckland. Transmissions: Sunday, Studio items and lecturette 3-4.30 p.m.; Children's service 6-6.55 p.m.; Church service relay 7-8.30 p.m.; General programme 8.30-9.30 p.m. Monday, silent day. Week-day sessions: General programme 3-4.30 p.m.; Children's hour 5-6 p.m.; Dinner programme 6-7 p.m.; News and market reports 7-8 p.m.; General entertainment 8-10 p.m. 333

2YA—R.B.C., Wellington. Transmissions: Sunday, Studio items 3-4.30 p.m.; Children's service 6-7 p.m.; Church Service relay 7-8.30 p.m.; General programme 8.30-9.30 p.m. Week-day sessions: General programme 3-4.30 p.m.; Sports results 4.30-4.50 p.m.; Childrens hour, 5-6 p.m.; Dinner programme 6-7 p.m.; News and Market reports 7-7.40 p.m.; Lecturette 7.40-8 p.m.; General entertainment 8-10 p.m. 416

3YA—R.B.C., Christchurch. Transmissions: Sunday, Studio items 3-4.30 p.m.; Children's service 5.30-6.30 p.m.; Church service relay 6.30-8 p.m.; General programme 8-9.30 p.m. Tuesday, silent day. Week-day sessions: Gramophone items 3-4.30 p.m.; Children's hour 5-6 p.m.; Dinner programme 6-7 p.m.; News items 7 p.m.; General entertainment 8-10 p.m. .... .306

4YA—R.B.C., Dunedin. Transmissions: Sunday, Gramophone items 3-4.30 p.m.; Children's service 5.30 p.m.; Church service relay 6.30-8 p.m.; General programme 8-9.15 p.m. Thursday, silent day. Week-day sessions: Gramophone items and sports results 3-4.30 p.m.; Children's hour 5-6 p.m.; Dinner programme 6-7 p.m.; News sessions 7 p.m.; Lecturette 7.40 p.m.; General entertainment 8-10 p.m. 463

"B" Class Stations

2YB—North Taranaki Radio Society in conjunction with N.Z.R.B.C., Empire Building, King St., New Plymouth. Sunday, children's service 6-6.40 p.m.; concert 8.15-9.45 p.m. Monday, children's session 6.30-7.30 p.m.; news and reports 7.30-8 p.m. Wednesday, children's session 6.30-7.30 p.m.; news and reports 7.30-8 p.m.; studio concert 8-10 p.m. 244

1ZB—La Gloria Gramophone Co., Karangahape Road, Auckland. General programmes daily (except Sunday) 10.30-11.15 a.m. Monday 2.30-4 p.m. and 7.30-10 p.m. Wednesday, 8-10 p.m. 275

1ZR—Lewis Eady & Co., Ltd., Queen St., Auckland. Station director T. Garland. Sunday, Children's sessions 9-9.30 a.m. and 7.30-8 p.m.; Church services 9.30-10.30 a.m. and 9-9.30 p.m.; Musical programmes 2.30-4 p.m., 6.30-7.30 p.m. and 8-9 p.m. Tuesday to Friday inclusive general programmes noon-2 p.m., 2.45-4.15 p.m., 5.45-6 p.m., 6.45-755 p.m. Children's session 6-6.45 p.m. Tuesday, Thursday and Friday, Concert programme 8-10 p.m. Saturday, general programmes noon-1.30 p.m., 5.45-6 p.m., 6.45-8 p.m. Children's session 6-6.45 p.m.; Dance programme 8-11.45 p.m. Monday silent 275

1ZS—McCabe's Radio, Newton, Auckland. General programmes daily 7.30-9.30 a.m.; Monday to Friday inclusive 5-6 p.m.; Monday and Thursday 8.30-10.30 p.m.; Sunday silent 211

1ZP—Johns Ltd., Chancery St., Auckland. Station director Victor L. Johns. General programme Tuesday and Thursday noon-2 p.m.; Wednesday, 7.30-9.30 p.m. .... .227

1ZQ—Keith's Radio Shack, Exchange Lane, Auckland Monday-Thursday, 8-10.30 p.m. Sunday, 4-5 p.m., music; 5-5.30 p.m. children's session; 5.30-6 p.m., tea time session; 9-10.30 p.m., popular programme 253

2ZD—Masterton. Popular programmes, Monday, Wednesday, and Saturday, Noon-2 p.m. Tuesday, Thursday and Friday 7-9 p.m. 254.5

2ZE—G. R. S. Allen, Main Street, Eketahuna. Wednesdays, 8-10 p.m., popular programme 248

2ZF—Manawatu Radio Club, Palmerston North, Wednesday, 6.15-7 p.m. Children's session; 7-9.30 p.m. musical programme; Friday, 7-9.30 p.m. musical programme; Sunday, 7-9.30 p.m. musical programme. Every third Friday is request night 285

2ZK—D. A. Morrison and Co., The Avenue, Wanganui. Wednesday, 6.45-9.30 p.m. popular programme; Sunday, 7-9 p.m. popular programme 505

2ZM—Atwater-Kent Radio Service, 258, Gladstone Road, Gisborne. General programme, Thursday, 8.10 p.m. Sunday, 7-10 p.m. 260

2ZR—Radio Specialties Ltd., Victoria Avenue. Wanganui. Popular programme, daily 10.30 a.m.-1 p.m. 492

3ZC—Home Recreations Broadcasting Service Ltd., Armagh St. Christchurch. Daily (except Sunday) 10-11.30 a.m.; noon-1.30 p.m. musical programmes; also additional on Tuesday, 2.30-4.30 p.m.: 6 10.15 p.m. popular programmes 250

This station also on S.W. Saturday 2.30-4.30 p.m. a service shortly to be extended to Wednesday and Friday afternoons 50

4ZI—Bachelor's Radio and Gramophone Services, Dee Street, Invercargill. Monday, Tuesday, Thursday, Friday, Saturday, noon to 1 p.m.. Wednesday and Saturday, 8 p.m. to 10 p.m. 258

4ZB—Otago Radio Association (Incorp.) P.O. Box 364, Dunedin. General programme Wednesday and, Thursday 8 p.m.-10 p.m. 277.8

4ZO—Barnett's Radio Supplies, The Octagon, Dunedin. Daily, except Sunday, general programme, noon-1 p.m., and 5 p.m.-6 p.m.. Friday 7 p.m.-8 p.m. 10 p.m. till 11 p.m. 277.8

NEW ZEALAND SHORT WAVE STATIONS

ZLW—New Zealand Government radio-telephone station, Wellington. Outwards to Skegness, inwards from Rugby, via Australia (Beam service) 27.3

ZLXX—Western Electric experimental station, Wellington. Tests on various wavelengths; also broadcasts 62.8

ZL2XP—Philips experimental station, Wellington. Experimenting on short and ultra-short waves .... Various

AUSTRALIAN BROADCAST STATIONS

New South Wales

2AY—C. Rice, 610, Dean St., Albury, N.S.W. 227

2BE—Burgin Electric Co., 340, Kent St., Sydney 316

2BL—A.B.C., Market Street, Sydney 353

2FC—A.B.C., Market Street, Sydney 451

2GB—Theosophical Broadcasting Station, Ltd., Adyar House, 29, Bligh St., Sydney 316

2KY—Trades and Labour Council, Goulburn Street, Sydney 280

2NC—A.B.C. Beresford, Newcastle, N.S.W. Relay station for transmissions from 2FC and 2BL, Sydney, N.S.W. 241

2UW—Radio Broadcasting, Ltd., Paling's Building, Ash Street, Sydney 267

2UE—Electrical Utilities, Ltd., 619 George Street, Sydney 293

2MO—M. Oliver, Gunnedah, N.S.W. 200

2MK—Molker Bros., Howick St., Bathurst .. 260

2HD—W. W. Johnston, International Bible Students' Association, c/r Darby and King Streets, Newcastle 288

2XN—G. W. Exton, Lismore, N.S.W. 224

Victoria

3BA—Ballarat Broadcasters Pty. Ltd., Ballarat, Victoria 231

3LO—A.B.C., 120A Russell Street, Melbourne 371

3AR—A.B.C., 120A Russell Street, Melbourne 484

3UZ—O. J. Nilson and Co., 45 Bourke Street, Melbourne 319

2DB—Herald Broadcasting Service, Flinders St., Melbourne 255

Queensland

4QG—A.B.C., Brisbane 385

4GR—Gold Radio Service, Ruthven Street, Toowoomba 294

3TR—Gippsland Broadcasting Service, Trafalgar, Victoria 234

South Australia

5AD—Advertiser Newspapers, Waymouth St., Adelaide 229

5CL—A.B.C. Adelaide 409

5DN—5DN Propty. Ltd., 2-4 Montpelier St., Parkside 313

5KA—National Musical Federation, Ltd., 81 Flinders St., Adelaide 250

West Australia

6WF—A.B.C., Perth 435

6ML—Musgrove, Ltd., Lyric House, Murray St., Perth, W.A. 297

Tasmania

7HO—Findlays Pty., Ltd., 80, Elizabeth St. Hobart, Tas. 337

7LA—Wills and Co., Launceston, Tas. 273

7ZL—Tasmanian Broadcasters Pty., 95 Elizabeth Street, Hobart 516

EASTERN BROADCAST STATIONS

KSMS—Shanghai	277
NKS—Shanghai	310
JOAK—Japan	345
JOFK—Japan	353
7BY—India	357
JOIK—Japan	361
JODK—Korea	366
JOCK—Japan	370
7CA—India	370
JOGK—Japan	380
JOHK—Japan	390
JQAK—Darien	395
JOBK—Japan	400
KZRM—Manila	413
RL20—Vladivostok	480
XOW—Nanking	495

SHORT-WAVE STATIONS OF THE WORLD

Call Letters	Station	Metres
	Argentina	
LSH	Buenos Aires	29.00
LON	Buenos Aires	48.30
LSG	Buenos Aires	15.02
	Austria	
UOR2	Vienna. Transmission temporarily suspended.	

AUSTRALIA

VK2ME—Sydney 31.28
VK2BL—Sydney 32.50
VK3ME—Melbourne 31.55
VK6AG—Perth 20.00

British Guiana

BZL—Georgetown 43.80

Canada

CGA—Drummondville, Quebec 32.00
CJA—Montreal 24.50
CJRX—Winnipeg 25.50
VAS—Glace Bay, N.S. 28.00

Costa Rica

NRH—Amando Cespedes Marin, Apartado 40, Heredia 30.90

Colombia

HKC—Bogota 48.80

Cuba

CM2LA—Havana 29.98
CM2MK—Havana 32.06

Dantzig

EK4ZZZ—Dantzig— 40.00

Denmark

OZ7MK—Copenhagen, Radioposten 32.05
OZ7RL—Copenhagen, "Popular Radio" 82.24
OXQ—Copenhagen .... 31.51 and 49.26

England

G5SW—Chelmsford 25.53
GBJ—Bodmin 16.10
GBP—Rugby (Telephone to Wellington) 27.7
GBK—Rugby 16.57, 26.10, 32.40
GBS—Rugby 16.38, 24.68 32.59 33.26
GBU—Rugby 16.11, 24.41, 30.15
GBW—Rugby 16.54, 20.70, 30.64
GBX—Rugby 18.56, 24.46, 27.75, 28.86

Fiji

VPD—Suva Radio 21.00

Finland

Helsingfors (Helsinki) 31.50

France

F8GC—Paris ("Radio LL") 61.00
FTN—Paris 24.6
Paris Experimental 29.00
Paris, Eiffel Tower 32.5
F8AV—Nogent 80.00
Radio Vitus—Paris 37.00
YR—Lyons ("Radio Lyon") 40.20
Agen 30.75
YN—Lyons 58.00
Nancy 15.50
FW4—Ste. Assise 24.50

Germany

DOA—Doberitz 67.65
AFL—Bergedorf 52.00
DIV—Koenigswusterhausen 14.06, 19.74, 13.95
D4AFF—Coethen 43.60
DOA—Doeberitz 40.00
DHC—Nauen 26.50
DGW—Nauen 14.83
Zeesen 31.38

Holland

PCJ—Endhoven 31.28
PCK—Kootwijk 16.30
PCL—Kootwijk .... 18.40 and 38.80
PHI—Eindhoven 16.88

Honduras

KRB—Tegucigalpa 48.62

Italy

I1AX—Rome .... 20.00 and 40.00
3RO—Rome 80.00
I3RO—Rome 25.4
IAY—Placenza .... 20.00 and 45.00
IMA—Rome 43.5

Indo-China

ARI—Saigon 49.00
FRE—Saigon 18.75
FZR—Saigon 23.9

Japan

JFAB—Taipeh, Formosa 39.50
JHBB—Ibarakiken (Hirasio) 37.50
JIPP—Tokio 20.00
JKZB—Tokio 20.00
JOAK—Tokio 30.00, 60.00, 35.00, 70.00

Java

PLE—Bandoeng 15.94
PLF—Bandoeng 16.8
PLG—Bandoeng 18.80
PLW—Bandoeng 36.92
PK3AN—Sourabaya 50.00

Kenya

7LO—Nairobi 31.00

Manchuria

RA97—Khabravosk 35.00
RV15—Karbarovsk 70.2

Mexico

XC51—Mexico City 44.00
XDA—San Lazaro 16.00
San Lazaro 21.3
San Lazaro 32.00

Norway

LCHO—Oslo 33.00
LGN—Bergen .... 31.25 and 30.00

Phillipine Islands

K1XR—Manila 26.20, 48.80

U.S.S.R. (Russia)

RDRL—Leningrad 28.50
RDW—Moscow 83.00
RV15—Kharbarovsk (Siberia) 70.20
RFN—Moscow 50.00
RA19—Tomsk (Siberia) 37.00

Siam

HS4PJ—Bangkok 37.00
HS1PJ—Bangkok 16.90
HS2PJ—Bangkok 29.5

South Africa

ZTD—Durban 40.5

Spain

EAM—Madrid 30.70
EAR110—Madrid 43.00

Sweden

SAS—Karlsborg	52.50
SAA—Karlskrona	44.40
Motala	99 and 41.45
SAJI—Karlsborg	47.00
SMHA—Stockholm	41.00

Sandwich Islands

KIO—Kahuhu	25.68

Switzerland

HB9OC—Berne	32.00
HB9XD—Zurich	85.00 and 32.00

Tunis

FM8KR—Constantine	80.00

United States

W2XAC—Schenectady, N.Y.	34.5
W2XAD—Schenectady N.Y.	19.56
W2XAF—Schenectady, N.Y.	31.48
W2XAL—Coytesville, N.J.	49.67
W2XAL—Coytesville, N.J.	25.42
W2XAL—Coytesville, N.J.	19.67
W2XAL—Coytesville, N.J.	13.97
W2XBR—New York, N.Y.	49.83
W2XCX—Newark, N.J.	49.34
W2XE—Jamaica, N.Y.	25.34
W2XE—Jamaica, N.Y.	19.63
W3XAL—New York, N.Y.	49.18
W3XAL—New York, N.Y.	31.35
W3XAL—New York, N.Y.	25.6
W3XAL—New York, N.Y.	19.83
W3XAL—New York, N.Y.	16.87
W3XAL—New York, N.Y.	13.95
W3XL—New York, N.Y.	49.83
W3XAU—Philadelphia, Pa.	49.5
W3XAU—Philadelphia, Pa.	31.3
W6XAL—Westminster Calif.	49.34
W6XAL—Westminster Calif.	19.67
W6XAL—Westminster Calif.	13.95
W6XN—Oakland, Calif.	23.35
W8XAL—Cincinnati, Ohio	49.5
W8XK—East Pittsburgh, Pa.	48.86
W8XK—East Pittsburgh, Pa.	31.35
W8XK—East Pittsburgh, Pa.	25.25
W8XK—East Pittsburgh, Pa.	19.72
W8XK—East Pittsburgh, Pa.	16.87
W8XK—East Pittsburgh, Pa.	13.93
W9XA—Denver, Colo.	31.48
W9XAQ—Chicago Ill.	49.67
W9XU—Council Bluffs, Iowa	49.5
W9XF—Chicago, Ill.	49.83
W9XF—Chicago, Ill.	25.42
W9XF—Chicago, Ill.	13.95

NEW ZEALAND RADIO
Handbook Annual

No. 2 Auckland, N.Z. March, 1931

FOREWORD

THE splendid reception accorded our 1930 Handbook has caused us to deal with wireless matters even more intensely on the present occasion, and it will be found, as a consequence, that this volume is considerably larger than last year's Handbook. We do not claim that this volume contains mention of everything connected with the science of wireless; but it will be found that little has been omitted which can reasonably be considered to be of interest to the majority of listeners in this Dominion.

In spite of the hard times which are now being experienced by the many and which have been experienced for some years, licence holders are gradually increasing in number in New Zealand, as in other countries, which clearly demonstrates that wireless broadcasting is becoming ever more widely recognised as the most economical form of receiving education and entertainment.

The large sale of our 1930 Handbook has proved that the listening public in New Zealand is not solely interesed in taking the broadcasts for the purpose of entertainment, but that there are many thousands of listeners in the country who, in addition to taking the broadcasts, wish to be informed in many other matters connected with the science of wireless, and are desirous to have always at hand a reference book dealing with wireless matters generally, and in particular with those wireless matters principally affecting the daily life and welfare of the people of this Dominion.

In compiling the present volume we have taken the above facts carefully into consideration, and, while we have not neglected to report briefly the progress of wireless throughout the world, the matters we have dealt with at length are such that are of the greatest concern to New Zealand listeners or which concern listeners generally throughout the world.

The volume will be found to contain articles by numerous writers well versed in the various branches of wireless with which they deal; but all have endeavoured to couch their articles in simple terms that they might be as readily understood by the beginner in wireless as by the advanced student, while the articles have been assembled in sections to enable the Handbook to serve equally well the technical and the non-technical wireless enthusiast.

LISTENERS AND LISTENING

ALTHOUGH broadcasting is now firmly established throughout the world as a means of receiving education and entertainment, there appear to be many listeners who do not realise fully the important part they are called upon to play in order to make broadcast reception thoroughy satisfactory. We hear much criticism—and more diatribe—regarding the broadcasters and the broadcasts; but it must be admitted that the listeners and their methods of receiving the broadcasts are also open to criticism. Just as there are correct and incorrect metnods of broadcasting, so there are correct and incorrect methods of taking the broadcasts, and it is my object here to mention briefly some of the matters it is incumbent on the listener to observe closely if he is to derive the greatest benefit and enjoyment from the broadcasts he receives.

It should be obvious to all listeners that the first essentials for satisfactory reception are the care of the set and the taking of the broadcasts at the correct volume; yet, although the majority of really interested listeners habitually keep their receiving sets in good working order, there are many who appear to pay little attention to correct volume control. Of course, the listener who desires to receive mere noise over the air, in preference to clear speech and tuneful music, will invariably use his loudspeaker at full strength, and will probably overload it to such an extent that the broadcast will be terribly distorted, even if it is intelligible. But the interested listener will not do these things deliberately: if he does them, he does them accidentally, and it behoves him to study volume control most carefully, that he may obtain the greatest possible clarity of sound from his set. This involves more than the mere tuning in of the desired station and obtaining the correct volume for one particular item: different broadcasts require to be received at different volumes of strength if they are to be received most satisfactorily, and nothing short of careful study of the set and speaker in use will enable the correct volume for each type of item to be obtained. This does not demand technical knowledge on the part of the set owner; but it does demand keen observation. No hard and fast rule can be laid down in respect of volume control, the correct volume will depend, for the most part, on the size, shape, and drapings of the room in which the broadcast is received, and should never be great enough to permit the slightest reverberation: any sound which is flung back from the walls will interfere with reception, as it will distort the sounds emitted by the loudspeaker. In a general way, the smallest volume which will give perfectly clear reception is the most desirable, and it is the duty of the set owner to find out for himself the most suitable volume for reception in respect of every type of item he receives over the air. Unless he does this he can never obtain the greatest possible amount of satisfartion from the broadcasts.

THE LISTENER'S ATTITUDE

If he is to derive the greatest value from the broadcast, the listener must place himself in the correct mental attitude to receive the broadcast which is coming in to him. This is not as difficult as it may appear: it consists merely in concentrating on the item to be received. The man who goes out to play golf does not concentrate on swimming or cricket: he concentrates on golf, if he is to play the game properly; and, if he is to listen properly, he must concentrate on the particular item being broadcast. If he cannot place himself in the correct mental attitude for the reception of a certain item, the listener should cease to be a listener while this item is being broadcast: he should switch off until something is being broadcast on which he can concentrate. The most dissatisfied listeners are generally those who listen too much: they become surfeited with broadcasting; they listen to so much that they suffer from mental indigestion. However much leisure a man may have, he should not listen all the time: it is just as possible to become intemperate in broadcast listening as it is in other matters. Those who listen intemperately will find it extremely difficult—probably too difficult—to place themselves in the correct mental attitude for the reception of all they receive over the air; it is much better to listen seldom and to listen well. If one is not in the mood to take a certain broadcast, it is a waste of time and a waste of electric current to take it: one does not eat food merely because there is food in the house, and one should not take the broadcast merely because there is a station on the air.

DO THE THING PROPERLY

When you do elect to take the broadcast, take it properly. You cannot take the broadcast properly while you are plaaying crrds, or reading a book, or taking part in a conversation, because you cannot give the whole of your attention to the broadcast while you are doing these things, and, in order to take the broadcast properly and to reap the full benefit from it, you must give the whole of your attention to whatever is being sent over the air.

Some time ago I went home with a friend after leaving the theatre. On entering his house, we found his daughter, a flapper of nineteen, half asleep and attempting to listen to the broadcast dance programme.

"I'm so disappointed," she told us, with a yawn. "Harry promised to come up to dance with me tonight, and he telephoned to say he'd sprained an ankle."

"Couldn't you have gone down to see Harry?" asked her father.

"I suppose that's what I should have done," came the reply, "but there isn't a wireless set at his place."

When I was about to leave, some twenty minutes later, the girl was asleep in her chair and the dance programme was still roaring through the loudspeaker. The father switched off the current.

"Aren't you going to wake the child and send her to bed?" I asked.

"No," replied the father. "One has to be cruel to be kind sometimes. The wireless glutton has to learn through suffering, just like every other kind of glutton. She'll probably wake up, half frozen, about three or four o'clock in the morning, and crawl up to bed. She's done that often, but it's becoming more infrequent now."

This is probably an extereme case, but it will serve to illustrate my meaning of the indiscrimination of the gluttonous listeners, and there are thousands of them: they do not get the best out of the broadcasts, because they do not choose their items with care, but take everything that is offered, whether they want it or not. When the man of refined taste enters a restaurant he selects a well balanced meal with care and eats just sufficient to gratify the appetite; the result is that he reaps satisfaction from his meal. When the gourmand enters a restaurant he shows no discrimination in the choice of his meal: he eats whatever he fancies, and he eats as much of it as he can; the result is that he reaps indigestion from is meal in most cases. In like manner the discriminating listener reaps mental satisfaction from the broadcast, whereas the gluttonous listener often reaps mental indigestion.

USING THE IMAGINATION

If the listener is to reap the full benefit from the broadcast he must do more than choose his items with discrimination. He must bring his imagination into play while he is listening, especially when he is listening to music which is not accompanied by words to explain its full meaning. Most of the better class musical compositions, you will find, have their meanings suggested by their titles, and these titles will almost invariably suggest something to the imagination of the correct listener. Charles Camille Saint-Saens composed several pieces to each of which he gave the name of a different animal or bird. Probably the best known of these compositions is "The Swan." This piece of music is obviously not intended to reproduce the notes of the swan, because the swan is not a singing bird. The music is intended to convey to the listener the stateliness of the swan, its gentle movements, and the soft ripple of the water as the bird glides gracefully upstream against a lazy current.

It is not until the listener brings his imagination into play while listening to music of the better class that such music can be fully appreciated, although enjoyment may be obtained while listening in a casual manner without trying to understand precisely what the composer intended to convey. The more the listener tries to undertsand the music, the more he will appreciate it; not merely because he is obtaining more than casual entertainment, but because he is doing his part in the entertainment in trying to get the most out of the music and thereby concentrating on it to the exclusion of all else. There is always a right and a wrong way to accept a thing; and this applies to music as it does to everything else, whether the music is heard over the air or in the concert hall.

LISTENING WITHOUT UNDERSTANDING

For those who wish to listen without effort there are hundreds of pieces broadcast under the name of music which are neither real music nor mere noise. These pieces do not call for the use of the listener's imagination, and they place no strain on the understanding, because there is nothing in them to understand.

Why does a doctor order his patients to eat tripe? Because they have weak physical digestions. Tripe is neither expensive nor epicurean; but it is easily digested. In like manner, the pieces to which I refer are easily digested mentally; they can be taken over the air while the listener is engaged in conversation, and, should he happen to miss part of the broadcast, he will not worry, because he knows he has not missed anything of value. They make no demand on the listener in respect of finding their meaning: they are meaningless, and, frequently, their titles are meaningless also.

Of course, one may meet, now and again, people who can do two things at once, and do them both well. I once met a man who could write a private letter while he was reading aloud from the news column of a newspaper; and I have heard of a typiste who could transcribe her shorthand notes correctly on the typewriter while she was carrying on a perfectly intelligible conversation with her friends. It is likely that you have met similar people; but you will admit that they are rare, extremely rare. A person similar to those I have mentioned is abnormal, and probably does not constitute more than one in a million; but it must be remembered that the broadcast is not made for that person alone, it is also made for the 999,999 who go to make up the million. This is a fact which appears to be overlooked by many listeners. Were the broadcast to give complete satisfaction to one listener, it would inevitably give dissatisfaction to the rest; but it is certain that the broadcast would give greater satisfaction all round if listeners would realise that they have certain duties to perform in respect of correct listening, and would carry out these duties to the best of their abilities.

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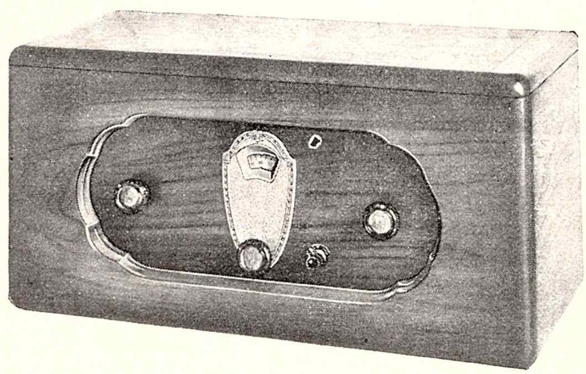

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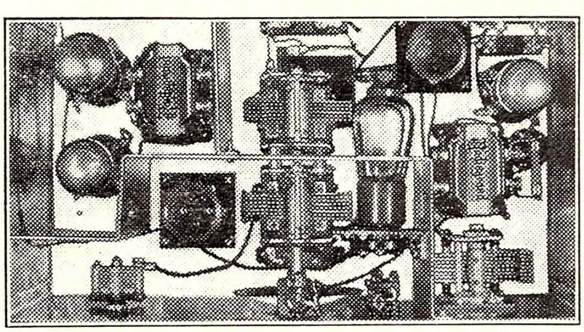

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WORLD'S WIRELESS PROGRESS IN 1930

THE world's progress in wireless broadcasting during the year 1930 was so great and included such a large number of features that it would be impossible to deal with all of these features in a large volume, even were it possible to collect information regarding all matters which have occurred to assist in this vast progress. The present article must, therefore, be confined to the mention in brief of some of the more important matters which influenced the progress of wireless broadcasting throughout the world during the past year, and in recording in some detail two or three of the more important matters which are of interest to the people of our own Dominion.

During 1930 there were two full meetings of the International Broadcasting Union: the General Assembly at Lausanne, Switzerland; and an autumn conference at Budapest, Hungary. The year was a most important one for the Union: a special committee met in Paris to discuss constitutional matters, there was heavy current business for several committees, while the frequency-checking station at Brussels, now under official control, has been working full time.

The exchange of programmes internationally, for which much preparation was made in previous years, was carried out successfully on several occasions and between several countries: these exchanges, however, must be regarded principally in the nature of experiments; but the present year is likely to see these programme exchanges organized as definite services, and the development of the system will be watched with interest.

THE VALUE OF WIRELESS

The great value of wireless has been emphasized on many occasions during the past year, but on no occasion was it shown more clearly than during the sinking of the S.S. Tahiti, on which occasion—what but a few short years ago must have been a great disaster—the whole of the vessel's passengers and crew were rescued with the minimum inconvenience. This was merely one of the occasions during the year when wireless communication was responsible for averting disaster at sea; but it is the instance which is of great interest to New Zealanders as it concerned a vessel which regularly visited this country, and which had but recently left Wellington when it met with the unfortunate accident which resulted in its sinking. It was on this occasion that the value of wireless as a utility service—as distinct from an entertainment service—was brought home most clearly to the people of this Dominion. At that period many New Zealanders whose sets were capable of bringing in the messages sent out on the short waves listened with breathless interest to the messages sent from and to the sinking vessel, and this personal experience of the value of wireless for averting disaster clearly showed these listeners that the entertainment side of broadcasting is but a minor item for which wireless may be applied, and that the entertainment value of wireless is remarkably small compared with its utility value.

EDUCATIONAL BROADCASTING

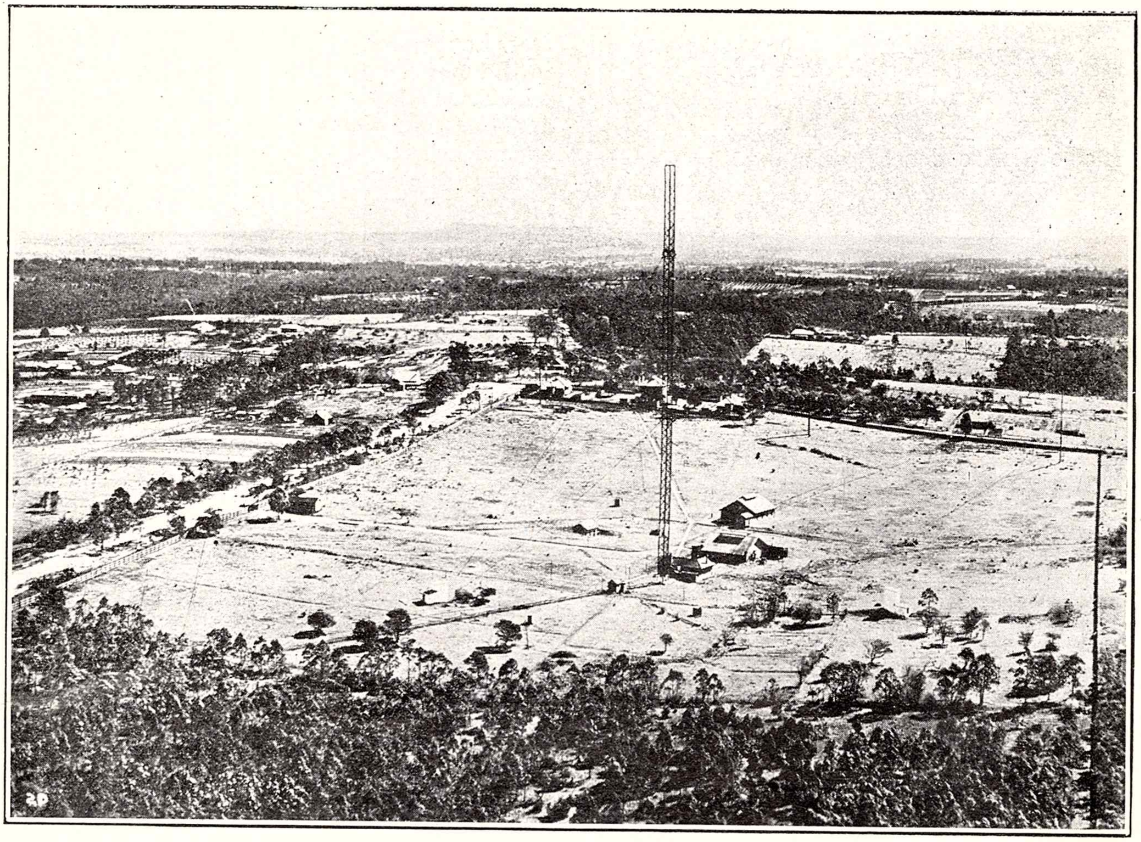
Another feature of the utility value of broadcasting, a feature which unfortunately has barely commenced to develop in this Dominion, has been shown in several countries during the past year. The progress which has been made in educational broadcasting during the past year is, however, almost insignificant compared with what may be expected in the near future. Nonetheless distinct advances have been made in some places.

It is some years ago since the Russians led the way in the matter of broadcasting information by the putting of political propaganda over the air. Although many in this country and elsewhere resented the type of matter broadcast from the Russian stations, it cannot be gainsaid that this action on the part of the Russians paved the way for the broadcasting of educational matter on a large scale. During the year under review the Germans, who had already started in the previous year to infuse a large quantity of educational matter into

their broadcasts to children, further developed the system and developed it on such lines and with such success that the child listeners in Germany have increased largely in number. Switzerland took the matter somewhat further in developing extension classes over the air, and in making it compulsory, in some districts, for scholars who had left the primary schools, but were unable to attend continuation classes at the night schools or secondary schools on account of the isolation of the districts in question, to take these continuation lessons over the air. This, it will readily be admitted is a most laudable innovation : those who have resided or who are residing in the New Zealand back-blocks are fully aware of the advantages held by town children over country children in obtaining further necessary schooling after leaving the primary schools. The Swiss system cannot be said to equalize matters for the town and country children ; but it certainly removes many of the disadvantages under which the children in the country districts have so long suffered.

In regard to broadcasting stations which are devoted principally, if not entirely, to the broadcasting of educational matter it is noteworthy that no less than nine per cent. of the broadcasting stations in the United States of North America are registered as education stations. In addition to the fifty-four stations thus registered there are many others in that country which devote varying portions of their broadcasting time to the dissemination of educational items,and there is no doubt that, during 1930, U.S.A. was the best served country in regard to the amount of educational matter which was sent over the air. As the taking of these broadcasts is not compulsory in U.S.A., the recognition of the value of this class of broadcast matter is evident from the large number of stations which devote the greater part of their broadcasting time to it.

More or less marked advances in educational broadcasting are recorded from many other countries ; in New Zealand advance in this direction has consisted chiefly in the broadcasting of utility talks to the farming community, and it is pleasing to note that these talks to farmers from our main broadcasting stations have been eagerly taken and greatly appreciated by farmers engaged in the various branches of farming from the North Cape to the Bluff.



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Modern Broadcasting Methods

CONSIDERABLE advance in broadcasting methods has been made in many countries during the past year the principal methods for improvement adopted being the building of stations of higher power, the building of relay stations, and the introduction of regional schemes.

It is but a few short years ago that our main stations were constructed and equipped with what was then considered adequate power for serving the districts for which they were intended. At that period the high powered stations which have since been built were possibly dreamed about but few expected that so many of these would be established in such a short time. Yet the general increase in power at stations throughout the world has become so marked in the short time since our first main stations were built, that these stations have now fallen into what is considered the low-powered class, and are extremely weak compared with many of the more modern stations.

When 50 kilowatt stations were erected and put into use in U.S.A., it was asserted by many that the limit in power had been reached and that higher powered stations than these could be required nowhere. These stations did not remain the world's highest powered stations, however, and increase in power has become general during the past year.

WORLD'S MOST POWERFUL STATION

A most ambitious scheme has been adopted in Poland. It is intended that it shall be made possible for every listener in Poland to receive the Warsaw broadcasts, even though nothing more powerful than a modest crystal set is used. To this end a super-power station was erected in Warsaw during the past year, having a power of 160 kilowatts making this the world's most powerful station. This station was completed and put into operation at the end of the year, and it is significant that the whole of the transmission equipment was manufactured in England. There still remains much to be done to bring the Polish scheme to full fruition, but the construction of this super-power station at Warsaw is certainly one of the outstanding features of the world's progress in wireless broadcasting during the past year. Beside this powerful station some of the stations which were recently looked upon as high powered now appear weak. Of course, there must be a limit to the power to be used at a broadcasting station, but, apparently, that limit has not yet been reached.

It is also reported that the new German stations which have been built and are in process of construction have been planned that their power may be doubled within one month if and when required. In view of the rapid increase in power which has taken place during the past year in a general way this provision made at the new German stations has much to recommend it. This is included in the re-organization plan for broadcasting throughout Germany, a plan which it was commenced to put into operation in 1930, but which is not yet completed. Germany's re-organization scheme, therefore, cannot be placed in its entirety as a feature of the year's progress.

THE BRITISH REGIONAL SCHEME

The British regional scheme is not yet completed and cannot, as a consequence, rightly be included as a feature of last year's progress as a complete scheme; but the larger part of the work was carried out during the past year, and this part constitutes such a large percentage of the work that it necessitates brief comment here. Under this scheme it is intended that every listener in Great Britain who possesses nothing more powerful than a one-valve set shall always have two programmes at his command from which to choose. These comprise the national programme and a local programme, and the listener will be able to choose from both programmes the items which appeal most to his taste. It is intended, when the scheme is put into operation, that the items at the two stations concerned shall be so timed that items of a similar character shall not be broadcast simultaneously at the two stations, while the owner of the more powerful receiving set will still be able to range over Europe as he is wont to do at present.

Relaying work has also been given much attention in other places, largely for the purpose of the international exchange of programmes; special relay lines have been laid for the transmissions, as distinct from the system of using the main telephone lines for relays, which is the customary practice in New Zealand at the present time.

SHORTENING THE WAVELENGTH

An enormous amount of experimental work was carried out during the year in short wave broadcasting. With the equipment now available to the majority of transmitters, particularly to amateurs, the thirty metre band still continues to give the most satisfactory results; but the most important work that has been carried out by the experimenters has consisted in the shortening of the wavelength. Prior to the opening of 1930 the ten metre band was very little used; but much has been achieved on this band during the year, and successful experiments have been carried out by some on the five metre band. The use of the wavelengths between five and ten metres is likely to become much greater in the near future as the result of these experiments.

Other experimenters, especially the Russians, have been working assiduously with the ultra-short waves, waves of less than one metre. Nothing of practical use can be said to have been achieved by these experiments up to the present.

Empire Broadcasts

IT is in regard to wireless developments within the Empire, especially insofar as they affect this Dominion, and with wireless developments in the Dominion that New Zealanders are most concerned ; these, therefore will be dealt with here in some detail, although space does not permit all the available information being given in these pages.

The geographical situation of our islands has long been looked upon as one of New Zealand's main disadvantages, but the past year's developments have proved conclusively that these disadvantages have now been removed, as far as wireless is concerned, and that New Zealanders may now be provided with reports of doings at the centre of the Empire as these events occur, and that, in a wireless sense, New Zealand is as close to the centre of the Empire as is any other of Britain's numerous Dominions and Colonies.

THE ROYAL BROADCAST

The above facts were appropriately made clear on January 21, 1930, when His Majesty, King George V, opened the London Naval Conference in the House of Lords. Arrangements were made for a world broadcast to be made of the opening of this International Conference. These arrangements were made by the B.B.C. and the broadcast was put through five different channels for reception outside Europe. The channels selected were the following:—

(1) G5SW, the B.B.C.'s Chelmsford experimental short wave station.

(2) The Rugby Transatlantic telephone service to New York.

(3) The experimental Beam telephone service to Canada.

(4) The experimental Beam telephone service to Australia.

(5) The Beam telephone link to Japan, which was still in an early experimental stage.

No further arrangements of a definite nature were made for the world broadcast, but such was the interest and enthusiasm in the broadcasting of the speeches delivered at the opening of this International Naval Conference that a large number of short wave stations joined in and gave valuable assistance. In Holland, Noordwijk picked up the speeches from 5XX, Daventry, and PCK, Kootwijk, passed them on to Java where they were again sent out by PMP and PLE. Two or three stations in U.S.A., also co-operated for westward transmission, while several stations gave their assistance for transmission eastwards.

It was extremely unfortunate that in Australia, in spite of the splendid preparations made for reception, little success was achieved ; but the broadcast was successfully received in this country through G5SW in England, 2XAF in America, and PLE and PMP in Java.

OTHER IMPORTANT BROADCASTS

Other important Empire broadcasts made during the year 1930 from London were given from the Dominion Conference and the Indian Round Table Conference. The broadcasts from the latter Conference were received with astounding clarity in many parts of New Zealand ; indeed, in some parts the speeches were heard as clearly by listeners as if they had been spoken at our own broadcasting stations, thus proving that distance is of little account in wireless matters and that it is a great boon to this Dominion for the purpose of placing it in close and immediate communication with the centre of the Empire. Hitherto in this Dominion we have been compelled to content ourselves with abbreviated and frequently garbled messages regarding both Empire and International matters, sometimes receiving, weeks later, detailed reports of happenings which gave totally different reports from those contained in the earlier abbreviated messages. The broadcast, however, gives us the actual utterances of statesmen taking part in important meetings, and these reach us over the air free from all pruning trimming, and embroidery; giving us the lasting satisfaction of knowing that we are obtaining perfectly honest reports, which is not invariably the case in respect of cabled messages.

There is no doubt that the broadcasting of musical items has already done much both in this and in other countries to assist listeners in forming musical taste ; but the reception of these overseas broadcasts recording the speeches delivered in connection with important Empire and International matters has proved conclusively that wireless can serve a very much more useful purpose than that of broadcasting mere entertainment, and that the possibilities of broadcasting for utility purposes have by no means been thoroughly exploited as yet. Nonetheless the important world broadcasts which took place during the past year have undoubtedly paved the way for much more utility broadcasting in the near future.

More favourable comment was heard in these Islands regarding the Empire broadcasts than was heard regarding any other particular type of broadcast taken in the Dominion, proving conclusively that this type of broadcast in the future will be eagerly taken by a large number of listeners.

Wireless Telephony

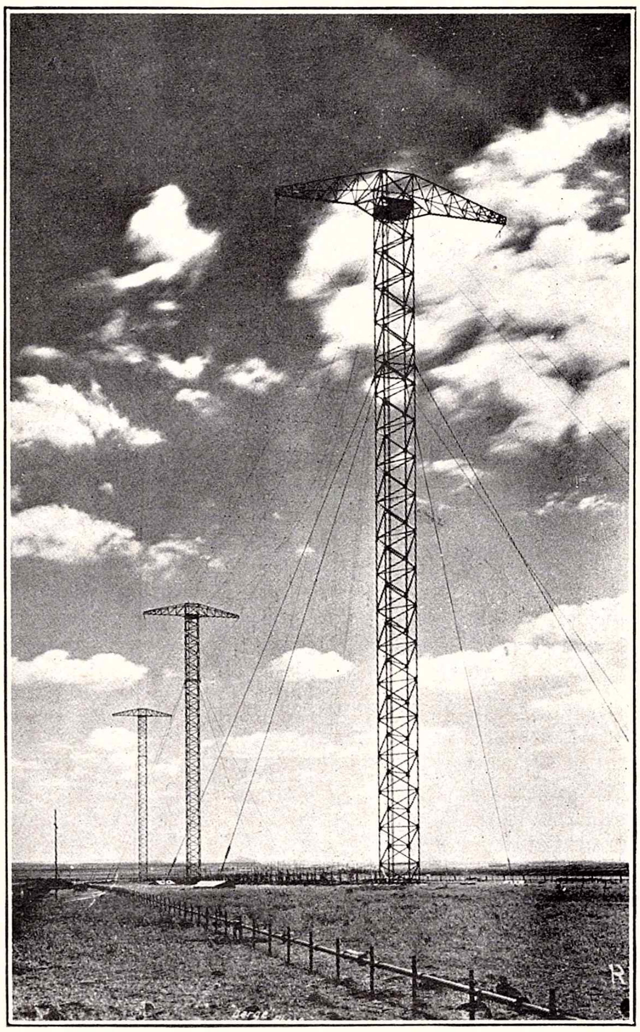
MENTION has already been made of the numerous wireless telephony services which were inaugurated in 1930; the most pleasing inauguration, from the New Zealanders' point of view, was the establishment of a wireless telephony service, from and to this Dominion, which came into operation towards the end of the year.

The peculiar geographical situation of New Zealand has long since caused thinking people to ponder on what might happen if a violent submarine disturbance—a likely occurrence—should suddenly cut off this Dominion from communication with the rest of the world. A slight foretaste of this was given to us about two years ago, on the occasion of the series of earthquakes on the West Coast of the South Island. On that occasion several places near the West Coast were isolated for some days, some of them being completely cut off from communication with the rest of the country owing to the absence of wireless transmitting gear in those places. At the ports on the West Coast communication was kept up solely on account of the presence in the harbours of vessels equipped with wireless transmitting gear, communication by means of the telegraph and telephone land lines being completely interrupted.

It required little imagination to picture the plight of the Dominion were a more serious and widespread seismic upheaval to occur. A portion of the country had been isolated on account of the absence of governmental wireless services and it was solely due to the good offices of several private wireless transmitters that the isolation was not more widespread and did not extend over a longer period. It was undoubtedly this occurrence which, in a large measure, caused the New Zealand authorities to take rapid steps to instal a wireless telephony service as a safeguard. As a business service this new service is unlikely to reach any magnitude for some years to come; but the new wireless telephony station is a national asset, and is probably destined to be of much greater value for Government purposes than for commercial purposes. The present service is conducted via Australia, through station VK2ME, Sydney, which may appropriately be termed the clearing house for messages to and from New Zealand. Possibly the next advance to be made in this direction will be the introduction of a direct wireless telephony service between New Zealand and Great Britain: a service independent of the Australian stations, but connected up with the Australian stations, to assist the Australians in case of need.

The system put into operation late last year undoubtedly marks the greatest advance in wireless in New Zealand during 1930. The value of this service, in spite of the fact that it is not a direct service, cannot be over estimated, and its establishment has done much towards bringing this country into line with the other countries of the world in respect of wireless progress.

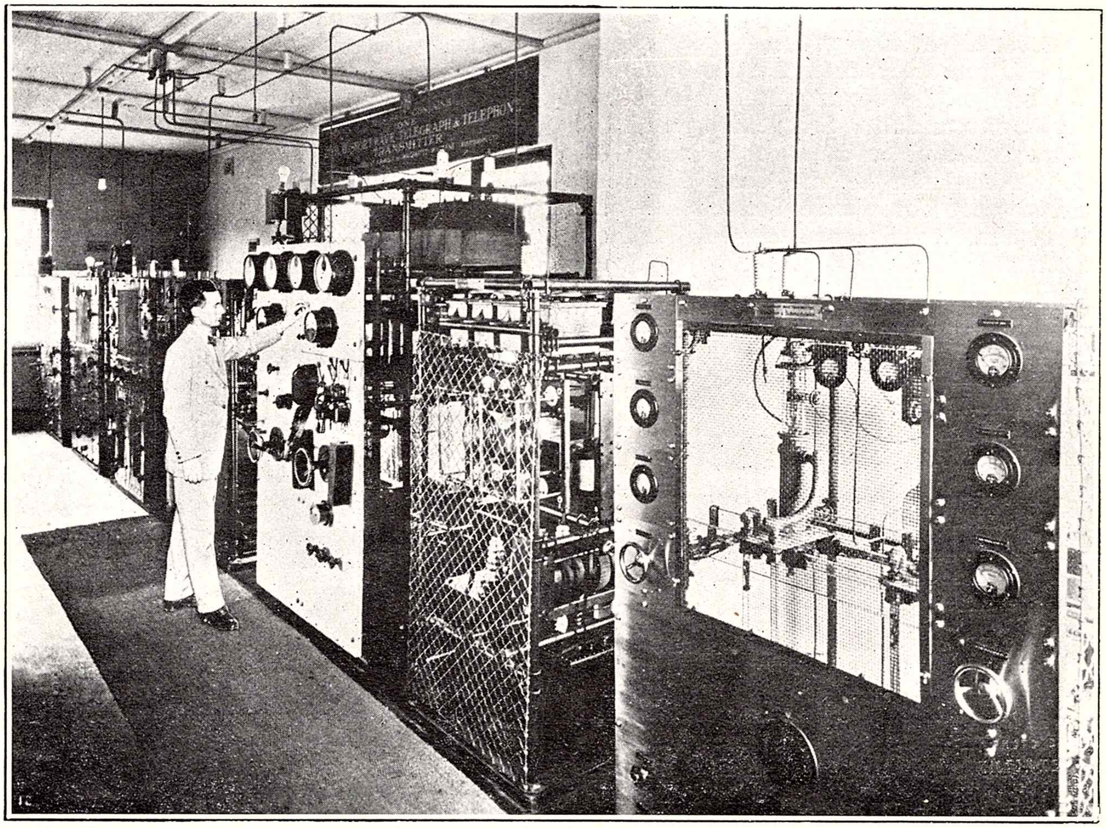
High praise is certainly due to the New Zealand authorities for the speed with which the undertaking was carried through to make overseas wireless telephony possible. It was not until April, 1930, that the wireless telephony service between Great Britain and Australia was opened. Thereafter little more than six months were allowed to elapse before the equipment at ZLW, Wellington, was installed and tests were being carried out between Wellington and Sydney. Before the end of the year the station was ready for service and conversations had been carried on between Wellington and London.



Portion of the Aerial System of the Beam Wireless Station of Amalgamated Wireless Ltd. at Ballan, Victoria.

The Wellington Station (ZLW)

THE Wellington wireless telephone station (ZLW) was officially opened on November 25, 1930, when, to mark inauguration of the radio-telephony service between Australia and New Zealand, a conversation took place between the acting-Prime Minister of Australia, Mr. J. E. Fenton, who spoke from Canberra, and the Minister of Native Affairs, Sir Apirana Ngata.



The famous 20 k.w. Telephony Transmitter at A.W.A. Radio Centre Pennant Hills, Sydney. Designed and manufactured by Amalgamated Wireless and used in the Wireless Telephony Service between New Zealand, Australia and Great Britain.

At a public ceremony in the afternoon about 50 persons were each provided with a separate earphone, through which they heard the conversations with remarkable clarity. The Minister of Railways, the Hon. W. A. Veitch, spoke to Mr. E. T. Fisk, managing director of Amalgamated Wireless, at Sydney, who sent greetings to New Zealand. He congratulated the officers of the New Zealand Post and Telegraph Department.

Mr. G. McNamara, secretary to the department, in replying, said he hoped that business men would appreciate the telephone, and would use it to the fullest extent.

Mr. A. Gibbs, chief telegraph engineer, when talking to Mr. Fisk, said the department was very pleased with the manner in which the apparatus had operated. It was hoped so to extend the system that 99 per cent. of the world's telephones would be placed at the service of New Zealand subscribers.

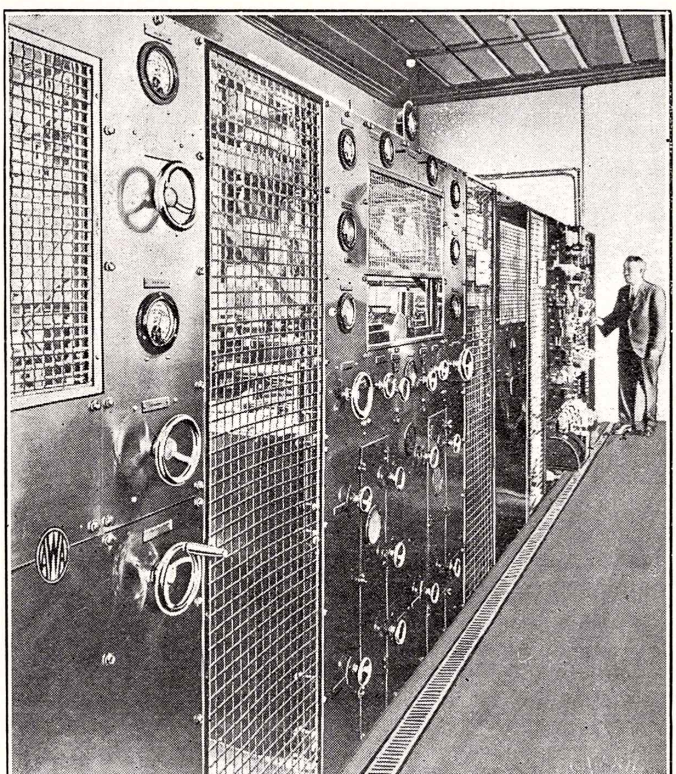
The inauguration of the wireless telephone service between New Zealand and London is an outstanding wireless achievement, bridging as it does a span of over 13,000 miles. In a great measure its successful operation is due to the efficient wireless engineering staff of the New Zealand Post and Telegraph Department, and to the experimental and research work of Mr. E. T. Fisk, managing director of Amalgamated Wireless, and the Company's technical staff.

By means of this service the marvels of wireless telephony are brought to your home or office. To ring up Australia or Great Britain, all that is necessary is to pick up your home or business telephone and ask for "Overseas Circuit." Between New Zealand and Australia there is a flat rate charge of £3 for a three minutes' conversation. No extra

charge is made for landline telephony connections either in New Zealand or Australia.

LOCATION OF STATION

The transmitting equipment at the New Zealand end is located at Tinakori Hills, Wellington, and consists of a 5 k.w. telegraph and telephone transmitter designed and manufactured at the Radio-Electric Works of Amalgamated Wireless and incorporating the most modern devices in telephony practice. The famous 20 k.w. transmitter at Radio Centre, Pennant Hills, Sydney—the Australian switching terminal of the New Zealand-London service—is the largest in the Southern Hemisphere, and was designed and manufactured by Amalgamated Wireless and is owned and operated by the Company. It is pleasing to note that several of the engineers engaged in telephony work by Amalgamated Wireless at the Australian end are New Zealanders, and that the installation of the Amalgamated Wireless equipment at Tinakori Hills, Wellington, was carried out by the engineers of the New Zealand Post and Telegraph Department.



5 k.w. Short Wave Wireless Telephone-Telegraph Transmitter designed and manufactured by Amalgamated Wireless and installed at the Goverment Radio Station, Tinakori Hills, Wellington. Mr. J. R. Smith, Officer-in-Charge P. & T. Laboratory is at the Switchboard.

METHOD OF WORKING

The method by which the wireless telephone service between New Zealand and London is carried out was explained by Amalgamated Wireless who designed and manufactured the short-wave transmitting equipment at Tinakori Hills, Wellington, to the order of the New Zealand Post and Telegraph Department, and who own and operate the transmitting and receiving equipment at the Australian switching terminal.

As one speaks into the subscriber's ordinary telephone the conversation is transmitted from the New Zealand transmitting station at Tinakori Hills, Wellington, and received at the Sydney switching terminal of Amalgamated Wireless at La Perouse, From thence it is transferred to the A.W.A. Transmitting Centre at Pennant Hills, Sydney, to be received at the Baldock receiving station in England. It is then automatically transferred to the London terminal to be heard by the English subscriber on his ordinary house telephone.

Conversation from England is relayed through the terminal switchboard at London to Rugby transmitting station, and is then transmitted to the A.W.A. receiving station at La Perouse, near Sydney. From here the conversation is switched via the mixing panel to the transmitting centre of Amalgamated wireless at Pennant Hills, Sydney, and then transmitted to the New Zealand receiving station at Wellington, to be heard on the subscribers, home telephone.

STATIONS' EQUIPMENT

The telephony equipment at Wellington Station comprises a 5 k.w. telegraph and telephone transmitter which was wholly designed and manufactured at the works of Amalgamated Wireless.

The 20 k.w. transmitting equipment at A.W.A. Radio Centre, Pennant Hills, and the receiving equipment at La Perouse, Sydney, were also designed and manufactured by Amalgamated Wireless.

The inauguration of this service brings all parts of the Dominion in telephonic communication with the Australian telephone system and with the telephone network of Great Britain, and in due course an extension of the service will be effected with the Continent of Europe.

The desirability of using radio telephony to ensure expediency in business matters is too apparent to need elucidation. Suffice it to say that an increasingly large number of Australian and English business men are availing themselves of the direct Australian-London radiophone service, and have come to regard its many facilities as an indispensable factor in the success of competitive business organisations.

The Connecting Link

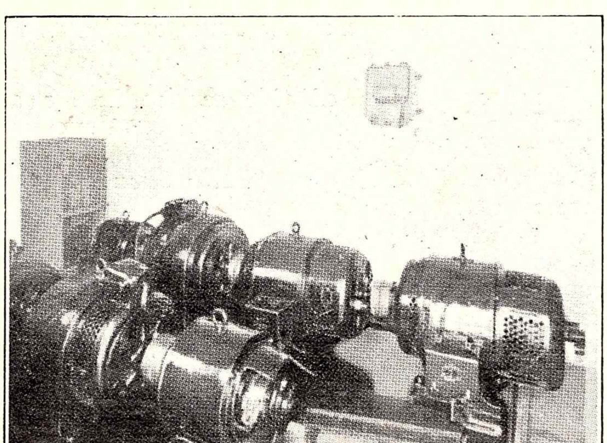
AS already has been stated, all messages sent to and from the Wellington station ZLW are ZLW, and commented on the service rendered by Sydney. The messages received from New Zealand at the Sydney station are transmitted to Great Britain by means of the Beam wireless service, and it is interesting to note what this system is and how it is operated.

The Beam wireless service between Australia and Great Britain and the Continent of Europe, owned and operated by Amalgamated Wireless (A/asia) Ltd., was opened for commercial traffic on April 8th, 1927, and almost immediately leapt into public favour. Additional Beam facilities were made available on June 16th, 1928, by the opening of the service between Australia and North and South America, thus providing not only direct communication with the New World, but also a second link with the Old World, via the Montreal-London Beam circuit.

The greatest long-distance direct telegraph service in the world, the Beam service, is operated entirely without retransmission or relays. It is by far the most speedy method of communication yet devised, the speed of working being limited only by the mechanical limitations of the manipulating and recording instruments at each terminal.

Beam wierless signals travel at the rate of 186,000 miles per second, and the sending apparatus handles the messages at the rate of 1,250 letters per minute. It will be seen that a message of 125 code words could be in London one minute after transmission commenced in Australia.

The Beam Offices of Sydney and Melbourne are open for traffic day and night. The doors are but ornamental—they have never been closed since the inauguration of the service.



Power Plant for Radio Telephony. R.M.S. Olympic

BEAM STATIONS

The Beam wireless transmitting centre in Australia is located near Ballan—about 50 miles to the N.W. of Melbourne, and the receiving centre is at Rockbank—18 miles from Melbourne in the same direction. Both stations are connected by special telegraph line with the Beam Wireless Offices of Amalgamated Wireless at Melbourne and Sydney. At Ballan, there are two transmitters—one of which is used for sending messages to London, whence they are distributed through the United Kingdom to Europe and the other transmits to Montreal all messages for the North and South American Continents. Much of the equipment is in duplicate—some in triplicate—to ensure continuity of service under all conditions. Both stations are under the supervision of a technical staff, whose duty it is to maintain the apparatus in efficient working order.

The transmission of messages originates at the Beam Offices in the heart of Melbourne or Sydney, and the Telegraph operators there, by means of special telegraph lines to the Beam stations, automatically cause the great transmitter at Ballan to radiate the messages and likewise messages from London or Montreal are received at Rockbank and automatically passed on to the telegraph centres in Sydney or Melbourne where they are recorded on tape.

BEAM TELEGRAPH OFFICE

A glance at the Beam Telegraph Room at Sydney or Melbourne convinces one that traffic routing and telegraph operating have fallen under the spell of the efficiency expert. Beam messages originating in Sydney and Melbourne are mostly collected by the Beam messengers, or are handed over the counter of the Beam telegraph offices. Messages lodged at the Post Offices throughout the Commonwealth are handed over to the Beam Office. As messages reach the Beam telegraph offices they are numbered, recorded and sorted according to their destination and class (full rate, deferred, daily letter or week-end letter) and distributed to expert machine telgraphists. A continuous stream of messages flows to telegraphists seated at high-speed automatic perforators. As quickly as an expert types the message is transcribed by this machine, but instead of recording it in letters of the ordinary alphabet, the machine punches it in the form of a series of small perforations on paper tape about half an inch wide, similar to music rolls in player pianos. There is a distinctive series of perforations corresponding to ordinary Morse characters for each letter.

The rate of transmission is much greater than the rate at which the operator can work a perforating machine and it is therefore necessary to keep

several operators employed punching tape to satisfy the high speed of transmission.

After the tape is "punched" it is passed through an automatic transmitter at high speed. This transmitter interrupts an electric current in the telegraph line connecting the Beam Wireless Offices at Sydney and Melbourne with the transmitting station at Ballan, Victoria, and actuates at high speed the automatic signalling relay at the transmitting station. Wireless waves, travelling at such high speed that they reach England or Canada —as directed—in a fraction of a second are radiated from the aerials as Morse characters of the message. The signals are picked up by the Beam Receiving Station at Skegness, England, or the Canadian Beam Station at Yamachiche, and are passed automatically to the Beam Offices in London or Montreal respectively.

Simultaneously with the feeding of the tape to the automatic transmitters, the message is being recorded by machines at the respective offices in London or Montreal. In glancing at the recording instrument next to the transmitter at Sydney or Melbourne Beam Offices, one can visualise the tape running through the machine at the other side of the world, and realise as never before, how wireless annihilates distance.

In addition to the Beam stations, smaller stations or units are required for collecting the outward traffic and feeding it to the main Beam stations, and also for distributing the inward Beam traffic to other States. These smaller units, known as Beam Feeder Transmitters and Beam Feeder Receivers, have been installed at practically every Australian capital. Two Beam Feeder Transmitters are located at Sydney, two at Mebourne, and one each at Adelaide, Perth and Brisbane. These stations transmit traffic direct by wireless to the Beam Traffic Office, Melbourne. From here is is automatically transmitted overseas via the Ballan Transmitting Station. The Beam Feeder Transmitting Stations at Sydney and Melbourne can be utilised almost immediately for exchanging overseas traffic should a mishap occur at Ballan Transmitting Station.

The success of the wireless telegraphic service between Great Britain and Australia led to further experiments, and eventually the wireless telephony service was established with equal success and put into general operation early in 1930. The development of the service between Great Britain and New Zealand is a natural extension of the Great Britain-Australia service, and the development of a direct wireless telephone service between Great Britain and New Zealand—a development certain to take place in the course of time—will result in a complete encircing of the globe.

Power Generating Plant at the Beam Wireless Station of Amalgamated Wireless Ltd. at Ballan, Victoria.

Whence the Messages Come

HAVING given our readers the essential particulars of the Wellington wireless telephone station ZLW, and commented on the service rendered by the clearing house in Sydney, it is appropriate now to supply some particulars regarding the station in Great Britain whence the messages come to New Zealand by means of the wireless telephone service. These messages are dealt with by station GBP, Rugby, England, one of the numerous wireless stations to be found on the large Rugby Station site.

The construction of the Rugby Radio Station was originally decided upon by the Government of the United Kingdom as a means of providing wireless *telegraph* communication of world-wide range throughout the whole of the twenty-four hours, with a sufficient margin of power to be effective by day and night, and also during conditions normally unfavourable to wireless reception. Rugby was the first high-power station to be constructed for equipment with thermionic valves, and it is still the most powerful telegraph transmitting station in the world. The telegraph transmitter was brought into service on 1st January, 1926.

The practicability of wireless *telephony* over long distances was established shortly after the building of the Rugby Station was commenced, and it was decided to add to the equipment at Rugby a wireless telephony transmitter which would give a commercial service to America in conjunction with a similar installation provided in America.

This telephone service was opened on 7th January, 1927. It was the first international wireless telephone service designed for connection to the ordinary public telephone subscribers' system, and it was also the first long-distance wireless telephone system brought into daily service in the world. It is still the only multi-channnel wireless telephone service in existence, and it carries an amount of traffic far in excess of that of any other wireless telephone service.

Amongst the unique features of the system is the adoption of what is technically known as "single sideband suppressed carrier transmission." By this means the power used is made six times more effective than the same amount of power would be if radiated from an ordinary telephone station such as is used for broadcasting: in addition, the band of wavelengths used in the ether is halved, so that interference with other stations is reduced to a minimum.

THE USE OF SHORT WAVES

The use of short-wavelengths for wireless telephony has enabled the adoption of highly directional means of transmission to be effected by means of combinations of wires in the form of aerial arrays having reflecting systems associated with them, sometimes referred to as "Beam" systems.

The cost of a short wave directional system is less than that of the long wave, mainly due to the fact that very high masts are not necessary. It is, unfortunately, not so reliable in operation as the long wave system; but the combination of the two systems has been the means of providing a reliable service to America over the full twenty-four hours of the day.

Unfortunately it is not economically possible to operate long wave wireless telephony to greater distances than from England to America, and the solution of the problem of providing telephonic facilities to the Dominions and other important centres is confined to the use of the short wave lengths.

Rugby is the selected location for the operation of all long distance wireless telephony services from England; and, with the exception of the American services, short waves are being used exclusively.

The Australian service, which is at present available for nine hours daily, has been in operation since 30th April, 1930. It affords direct connection between Australia and the United Kingdom, and also (by means of switching in London) with practically the whole of Europe. This service has now been extended to New Zealand, and service is given between the United Kingdom and New Zealand by means of switching in Australia.

Rugby is also the transmitting station for Ship and Shore telephone services, which are in daily operation with S.S. Olympic, Majestic, Homeric and Leviathan, and are available for extension to all ships which are equipped with suitable wireless telephone apparatus.

A criticism sometimes directed against wireless telephony is the absence of privacy, should attempts be made to intercept it. Considerable progress has, however, been made in preventing any intelligible reception of the transmissions by unauthorised persons. Already several channels are equipped with a device at the terminal position in London (where the transmitting and receiving stations are joined by land-line system) which renders the transmitted speech unintelligible, until it is restored to its normal quality at the distant terminal station.

DESCRIPTION OF THE RUGBY STATION PLANT

The site of the Rugby Station consists of 900 acres (roughly one and a half square miles) situated about four miles south east of the town of Rugby. Direct main-road access is provided by the ancient Roman road, Watling Street, which runs past the site, and the nearest railway station is Kilsby and

Crick, L.M.S. Railway, about one and a half miles distant.

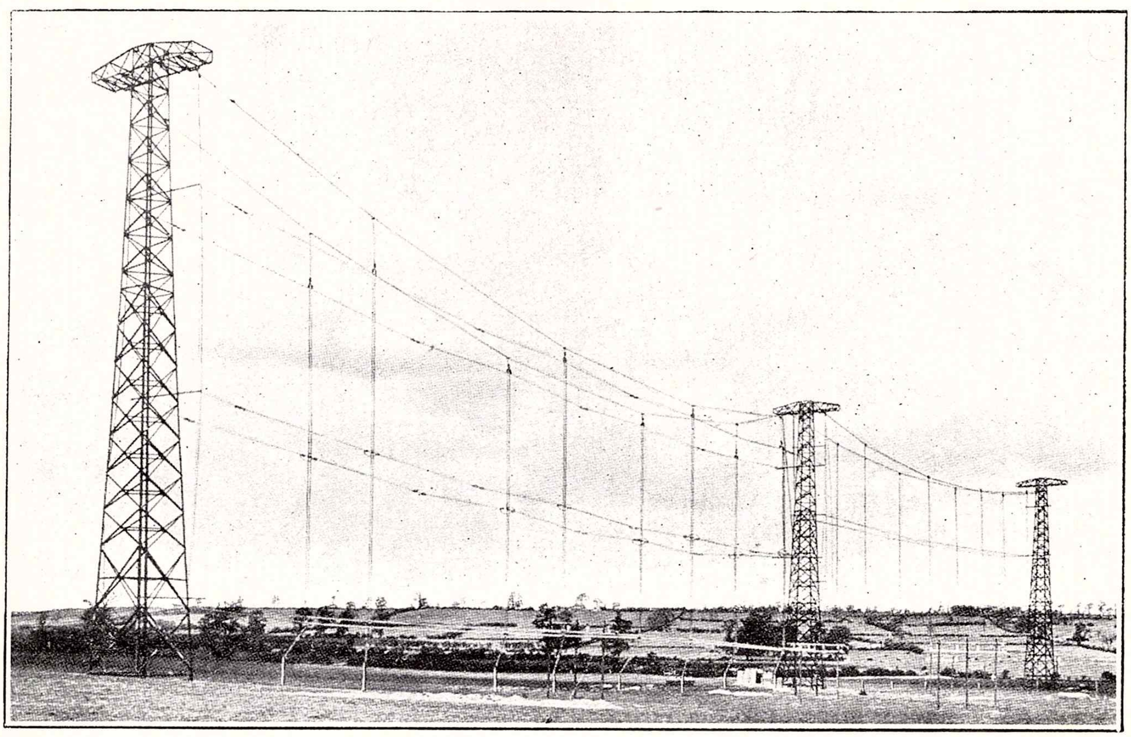
The station buildings consist of two groups, the Main Station, and the New Station. In addition, a farm-house situated on the south-eastern extremity of the site known as Handley Cross has been used as an experimental short-wave station.

Electric power is obtained from the system of the Leicestershire and Warwickshire Electric Power Company by means of two underground cables, each capable of taking the full load the station. The cables can be connected to either the Warwick or Hinckley power station, so that the risk of failure of the power supply is very remote. The incoming power supply is three-phase alternating current of 12,000 volts 50 cycles.

produced by them is projected in the line of the distant receiving station.

The two telegraph transmitters possess features of special interest. The larger, G.B.R., is the most powerful transmitter in the world, and is the only transmitter of this order of power operated by thermionic valves. All other transmitters of the same class are of the arc or alternator type.

This transmitter and the medium power transmitter are controlled in frequency by means of valve-maintained tuning forks. These forks vibrate at audio frequencies, and harmonics of the fork frequencies are selected and amplified in successive stages of the transmitter until the frequency corresponds with that of the emitted wave. From this stage the power is amplified in power



A Typical Short Wave Transmitting array at Rugby

The main aerial system is supported by twelve masts 820 feet high, of which eight are arranged in an irregular octagon, while the remaining four provide two extensions to the north. These masts support the antenna for the three long wave services in use, viz., the G.B.R. and G.B.V., telegraph channels, and the G.B.T. long wave transatlantic telephone channel. In addition, there is a number of antenna array systems of different types supported on steel towers and used for the short wave telephone services. The heights of these towers are 120 to 180 feet, and the directions of the array are arranged so that the sharp beam of radiation

amplifiers to the final output of the transmitter.

The long wave telephone transmitter, G.B.T., utilizes the single sideband system of transmission, while the remaining short wave telephony transmitters use the normal carrier and double sideband radiation.

The short wave telephone transmitters in general are arranged to operate on three wavelengths of the order of 16, 24, and 32 metres, and a set of three directive antennae of these wavelengths is provided for each transmitter. A change of wavelength can be carried out in a few minutes.

The frequency of the short wave transmitters is controlled by means of piezo electric quartz oscillators. These oscillators are maintained at a consistant temperature by means of thermostats and the frequency of oscillation is of the order of 2,500 kilocycles per second (120 metres wave). Harmonics of this frequency are selected and amplified to control the final output of the transmitter.

LIST OF EQUIPMENT

A guide to the various items of equipment to be seen at the stations is given in the following list:—

1. Control Table G.B.R. Telegraph Transmitter, 18,750 metres (16 kilocycles) 600 K.W. This is the most powerful wireless telegraph transmitter in the world.

2. Tuning fork drive units for G.B.R. The tuning fork oscillates at 1777.7 cycles per second, and the 9th harmonic is used to energise the transmitter at 16,000 cycles per second.

3. Intermediate stages for G.B.R. in duplicate, the fork unit drives a 1 K.W. glass valve, which in turn drives a 50 K.W. stage of three cooled-anode valves.

4. Final amplifier stages G.B.R., each panel contains eighteen cooled-anode valves.

5. Control table for long wave single sideband telephone transmitter G.B.T. 60 Kilocycles (5000 metres). This is the most powerful wireless telephone transmitter in the world. Output equivalent to broadcast transmitter of 1000 K.W.

6. Low-power modulating equipment in duplicate for G.B.T. producing single sideband.

7. Switchboards in duplicate controlling supplies to G.B.T. modulating equipment.

8. Intermediate amplifier G.B.T.—three cooled-anode valves.

9. Final amplifiers G.B.T.—30 cooled-anode valves.

10. Switchboard controlling high-tension direct-current plate supply to G.B.R. and G.B.T.; from high-tension generators 84 amperes at 7000 to 18,000 volts.

11. Low-tension switchboard, controlling filament and auxiliary supplies to G.B.R. and G.B.T.

12. Valve store room.

13. High-tension testing transformer; testing up to 75,000 volts.

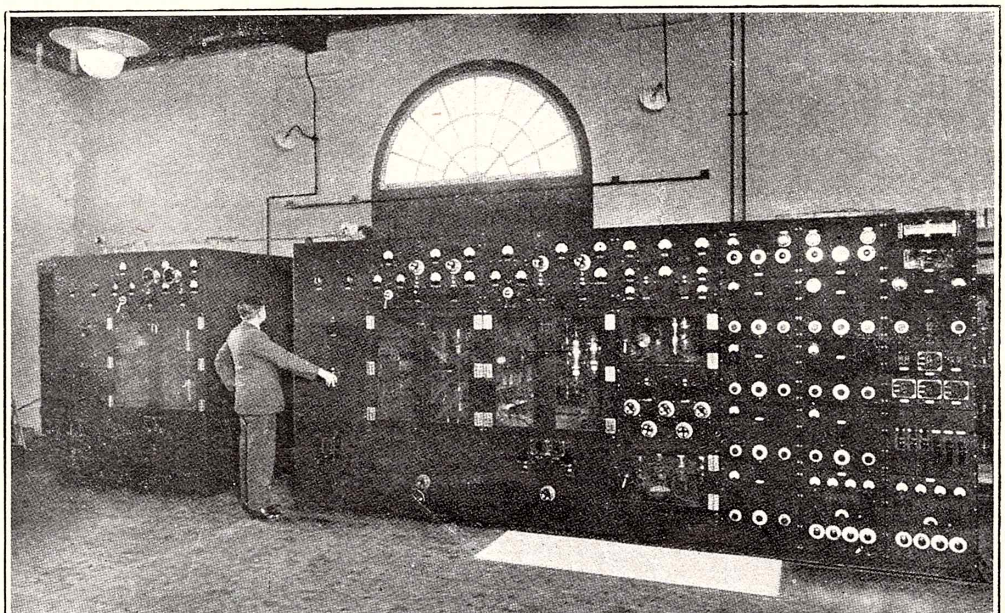
14. Valve-testing set.

15. Grid bias and low-power plate and filament supplies (G.B.R.)

16. Grid bias and low-power plate filament supplies (G.B.T.)

17. Tuning fork control panel (G.B.V.), medium power telegraph transmitter 78 Kilocycles (3840 metres) 60 K.W.

18. Rectifier and intermediate final amplifier (G.B.V.)



Short Wave Telephony Transmitter used on the Australian service

19. High-tension switchboard, incoming power supply three-phase 50 cycle 12,000 volts.

20. Feeder panels 12,000 volts.

21. High-tension three-phase 12,000 volt starting switches for main motor generators.

22. High-tension D.C. motor generator sets for plate supply to G.B.R and G.B.T. Each set 500 K.W. at 6000 to 7000 volts. All three sets can be connected in series by switches on busbar gallery to give 18,000 volts if required.

23. Motor alternator sets for filament current (G.B.R and G.B.T.). Output 200 K.W. three-phase 100 cycles driven by three-phase 50-cycle synchronous motors

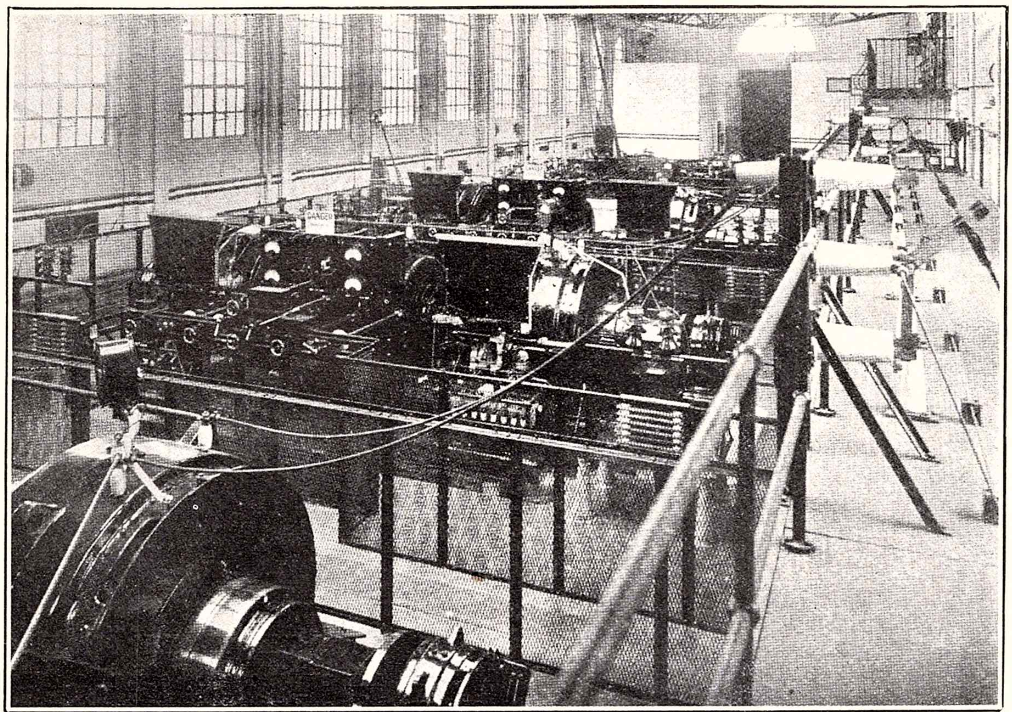
mitter and all the other short wave transmitters are controlled in frequency by a quartz piezo electric oscillator working on about 100 metres, the output of which is multiplied in frequency and amplified in eight stages. Used on transatlantic service.

30. Final amplifier G.B.S.—four water-cooled valves.

31. Rectifier for H.T. supply and high-power modulator equipment (G.B.S.). The set can be operated either by high-power modulation or low-power modulation.

32. Rectifier for H.T. supply, G.B.U. transmitter.

33. Crystal and low-power stages G.B.U. trans-



The Power Plant

24. Motor generator and booster sets giving 240 volts D.C. for station control circuits and battery charging.

25. Low-tension 416 volt A.C. 50 cycle three-phase and 240 volt D.C. switchboards.

26. Grid bias, filament current, and low-power plate current generators for G.B.S. short wave telephone transmitter.

27. Ditto for G.B.U. short wave telephone transmitter.

28. Speech input and testing equipment for G.B.S. and G.B.U. telephone transmitters.

29. G.B.S. short wave telephone transmitter (16.38, 24.69, 33.26 and 43.45 metres). This trans-

mitter (16.11, 24.41 and 30.15 metres) used on transatlantic service.

34. Intermediate amplifier stages (G.B.U.)

35. Final amplifier stage G.B.U.—four water-cooled valves.

36. High-tension 12,000 volt three-phase incoming supply; new station.

37. Low-tension 416 volt three-phase distributing switchboard.

38. Motor generator sets furnishing grid bias filament current and low-power plate supplies for short-wave telephone transmitters.

39. Speech input testing equipment for short-wave telephone transmitters.

40. Rectifier for H.T. supply. G.B.P. transmitter—used in Australian service.

41. Crystal control stages (G.B.P.)

42. Intermediate amplifier stages (G.B.P.)

43. Final amplifier (G.B.P.)—four water-cooled valves

44. Rectifier for H.T. supply to short-wave telephone transmitter G.B.W. used on transatlantic circuit.

45. G.B.W. transmitter—final stage four water-cooled valves.

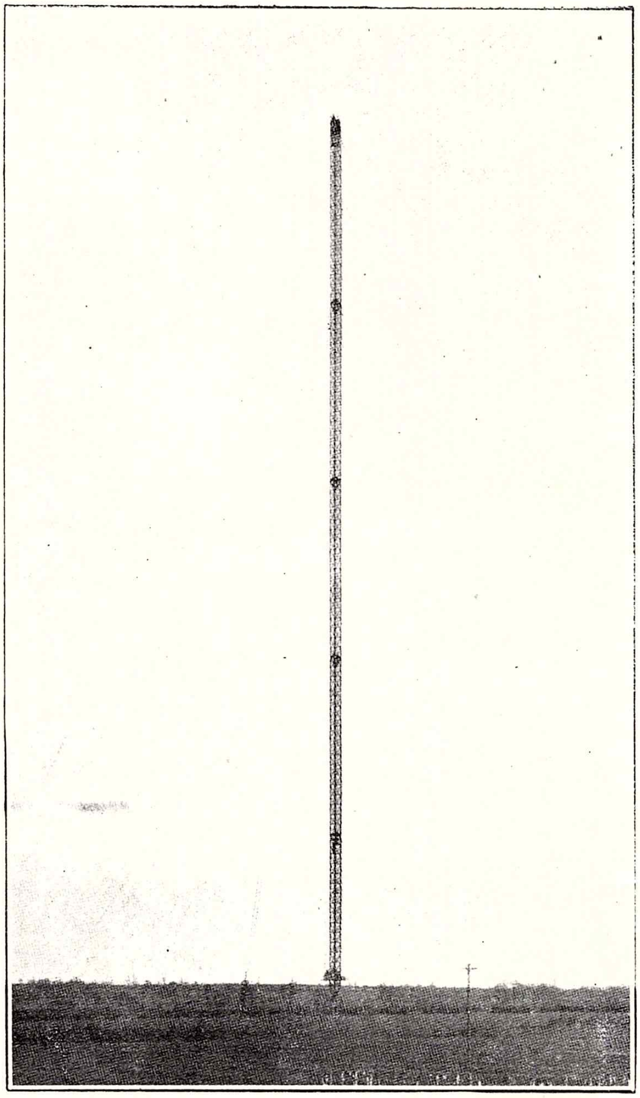
46. Rectifier for G2AA.

47. Transmitter G2AA—final stage two water-cooled valves. Used on Ship and Shore telephony service to S.S. Majestic, Olympic, Leviathan, etc.

48. Space allocated to new long-wave high-power single sideband telephone transmitter similar to G.B.T for transatlantic service.

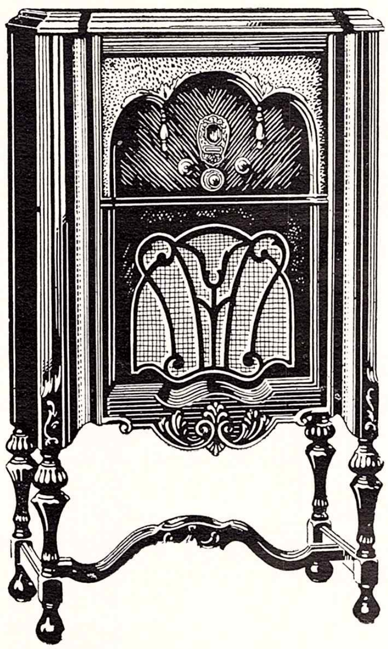
49. Space allocated to four new short-wave transmitters for service to South Africa, India, Canada and Argentina, etc.

Mr. E. T. Fisk, Managing Director of Amalgamated Wireless through whose pioneering efforts wireless telephony services are to-day operative in Australia and New Zealand.



THE RUGBY MASTS

No difficulty can be experienced in finding the station. The Rugby masts, twelve in number, are placed about 440 yards apart, and for a landmark for many miles around the station. They are 320 feet in height, and weigh approximately 200 tons each thy are triagular in shape, the three vertical posts of each mast being spaced ten feet apart. The system of bracing adopted between the vertical mmbers is known as K bracing. The base of each mast terminates in a tripod the lower portion of which forms a socket, The mast is thus capable of free movement about its lower extremity. The masts are insulated by means of porcelain and Swedish granite insulators, and each mast is supported by fifteen wire stay-ropes, each 1,000 feet long, ararnged in five groups of three stays. The mast are constructed to withstand a wind pressure of 140 miles per hour, and a horizonal pull of ten tons at the top.



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Further Developments

THE information given in the foregoing pages refers merely to a few of the many important developments in wireless during 1930, and principally to some of the developments of vital interest to New Zealanders.

The most strange thing in connection with wireless progress is not the rapidity of the rise of the science, but that such astounding advance has been made while wirless experimenters are still working in the dark: studying effects, while the causes remain hidden. We know that certain experiments, many of which have long since developed into commonplace functions, produce certain effects; but scientists are still seeking, as they have sought for many years, for definite knowledge regarding the still mystic force of wireless, are seeking to discover in what manner this elusive force is set up and the reason for its operation. Many theories regarding wireless have been put forward during the past year and during the years which went before it; but, in spite of the efforts of some of the greatest scientists the world has ever known, the wireless force remains a mystery insofar as none has yet been able to establish definitely what this force really is.

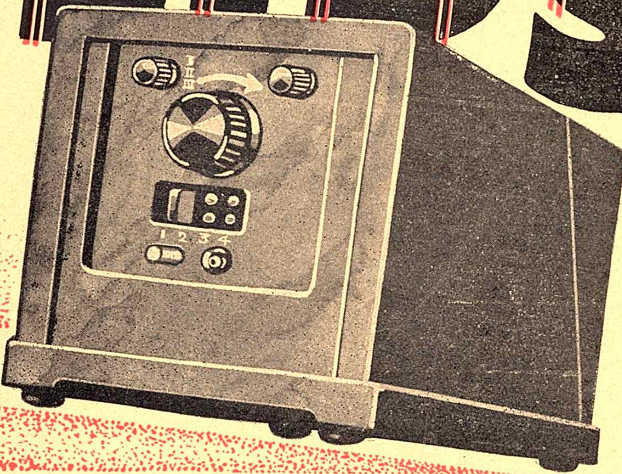
In that well known play, "The Silver Fox", it will be remembered that one of the characters states that the silver fox is continually on the move, seeking always something it will never find. It would appear that the wireless research worker is in a somewhat similar position. Every effort which has yet been made to discover the secret of wireless has resulted in failure: scientists have gleaned scraps of knowledge here and there, but the sum total of wireless knowledge gained up to the present leaves us entirely in the dark regarding the precise nature of the force.

What is wireless force? The question has been asked millions of times of millions of people; but it is a question which remains unanswered: in spite of the varied uses to which the force is daily being put and the astounding results which have been obtained all over the world by the application of wireless force. It is the nature of this problem to remain an enternal problem, a problem which will never be solved satisfactorily? Perhaps. This question cannot be answered with any more certainty than can the question regarding what the wireless force really is. It would be extremely gratifying to us to have this baffling problem of wireless solved that we might know precisely the nature of the force which is enabling such great benefits to be bestowed on us.

A Control of Philips Shortwave Station PHI, at Huizen

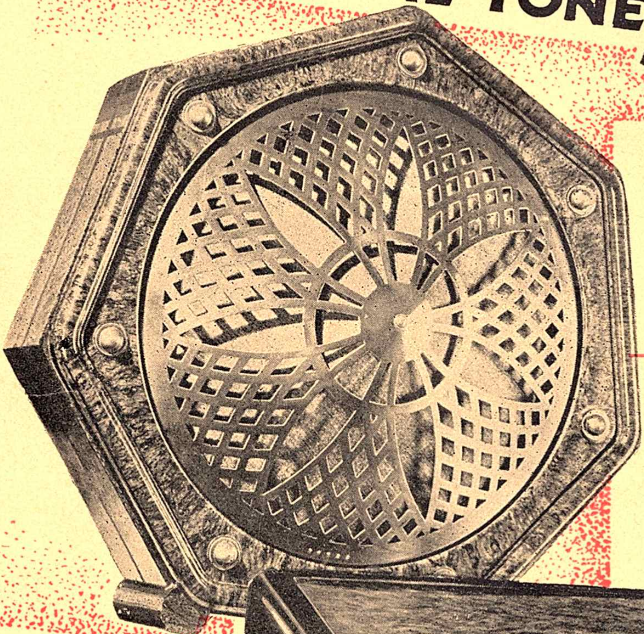
PHILIPS

AC QP 2516



Just plug into the light socket and hear your local station at full volume and as clear as a bell. No aerial, no earth, no batteries required. You can also use your "Q.P." to amplify your records electrically with a Philips pickup.

COMPARE THE TONE!

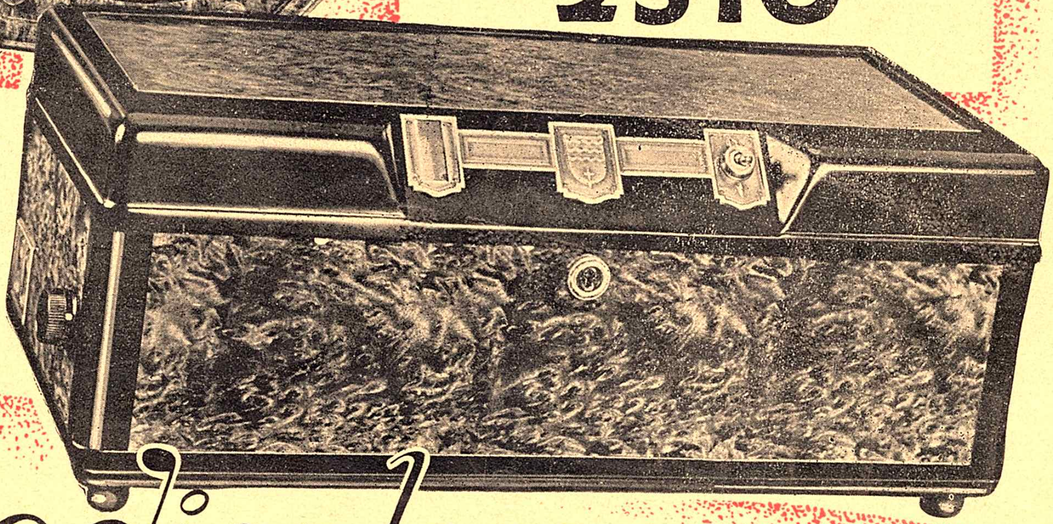


"SEVENETTE" SPEAKER

For superb reproduction—for full volume with every note and every intonation given its true pure quality.

Whether from broadcast or from your favourite records, the Philips 2510 Radioplayer renders perfect tone of a thrilling purity. Housed in an exquisite crystalline metal casing, it is the very latest acheivement of the world's cleverest radio engineers.

2510



PUSH AND THEY PLAY

radioplayers

. . . with a quality of reproduction never before considered possible of achievement . . . distance getters . . . ample volume . . and above all . . absolute purity of tone

2610 RADIO

HEAR THEM!

COMPARE THE TONE!

2810 COMBINATION RADIO & RECORD REPRODUCER

PHILIPS

CONSOLE MODEL

radioplayers

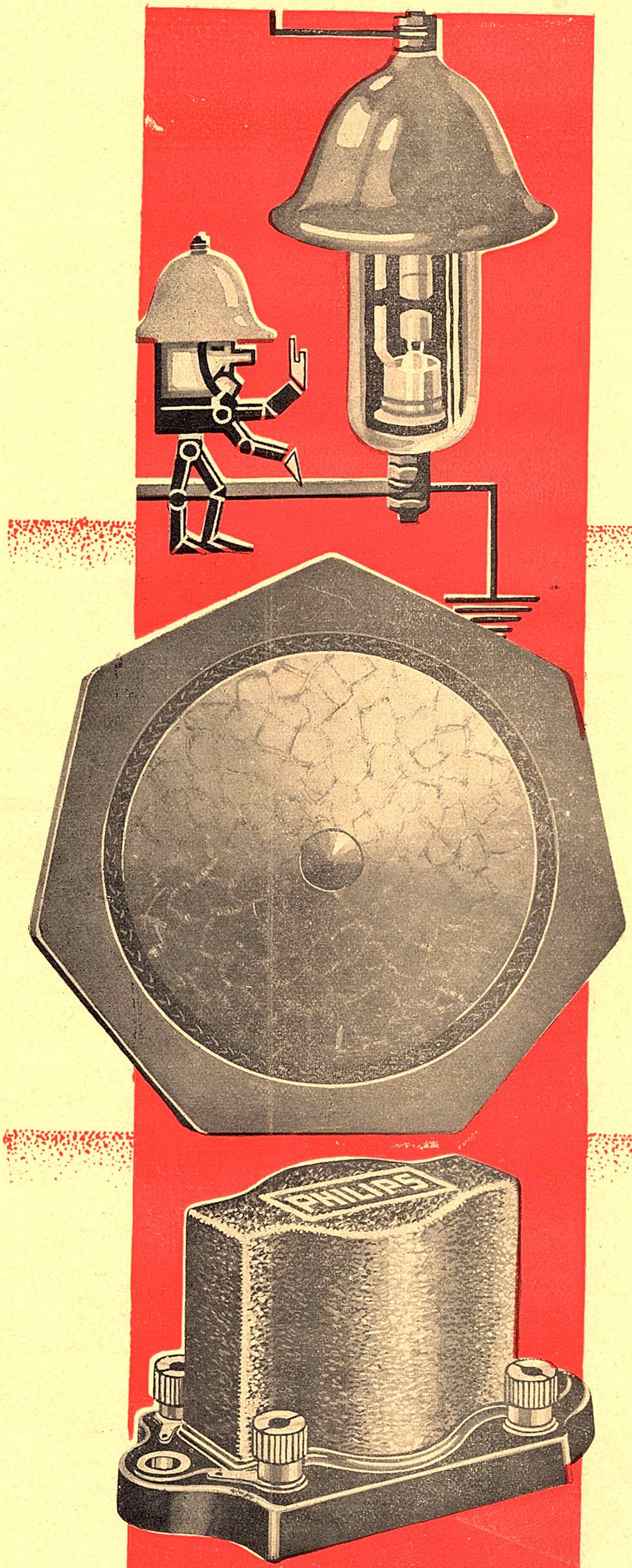
BETTER BECAUSE THEY'RE PHILIPS

PHILIPS for volume. Philips for Purity. Philips for long life. You cannot equip your radio with better valves than Philips ; better, because Philips engineers have pioneered the newest and best in Radio for years past Because every single Philips valve is made of the best material, in the best design, by the best workmanship.

AMERICAN AC REPLICAS

F 109A	Amplifier Directly Heated - -	14/-
F 209A	Detector & Amplifier Indirectly Heated	22/-
C 603	Power Valve - - - -	15/-
1 5 6 0	Full-wave Rectifier - - -	25/-

PHILIPS VALVES



STOP!

SAYS THE AERIAL COP

Here's your day-and-night sentry against atmospheric electricity It not only directs lightning discharges safely to earth; it also prevents ordinary high voltages in the atmosphere from damaging or destroying your radio.

Price **10/6**, complete with discharging fuse and spark gap.

PHILIPS AERIAL COP

LOW PRICED QUALITY

Can a speaker be really good at a low price? Definitely, yes! Look at the Philips "Baby Grand." Large full-floating cone: precision-built motor: and therefore ample volume and beautifully lifelike reproduction.

£3/15/-

PHILIPS "BABY GRAND" SPEAKER

AT THE HEART OF THE SET

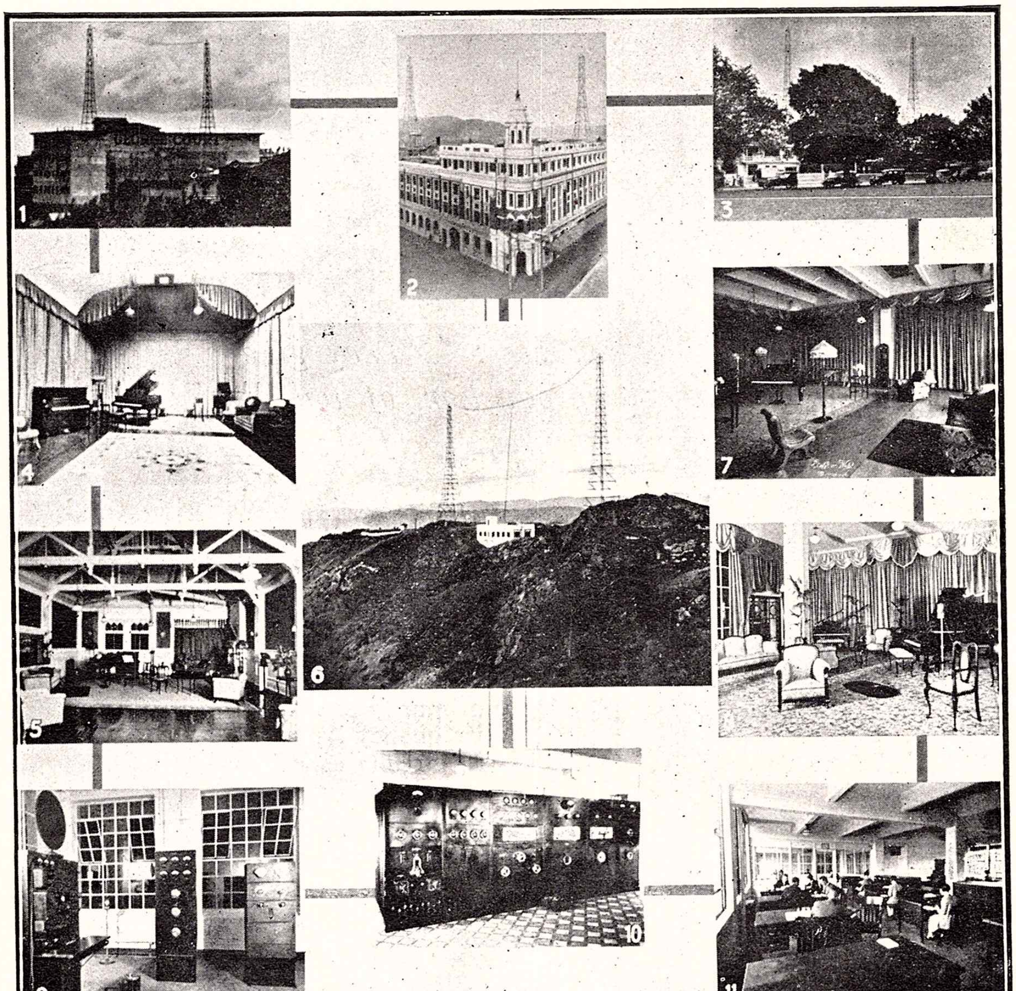
The best radio set is only as good as its audio transformer. Like all Philips equipment the Philips audio transformer admits only the very best material and workmanship. Completely shielded; pure silver primary: nickel secondary: remarkable cone: and "easy to get at" terminals. **25/-**

PHILIPS AUDIO TRANSFORMER

RADIO BROADCASTING IN NEW ZEALAND

THE best known landmarks in each of the four main cities of New Zealand are the graceful towers of the local YA stations

When the Radio Broadcasting Company of New Zealand Limited undertook the responsibility of supplying a broadcasting service to the people of the Dominion it was decided that the essential foundation to such a service was to have up-to-date stations and the most modern transmitting equipment; and with the thoroughness which has characterised its operations it erected stations which are a credit to New Zealand from the viewpoint both of appointments and efficiency.



(1) 1YA transmitting station on roof of premises of Messrs. George Court Ltd., Karangahape Road, Auckland. The aerial is 750 feet above sea level.

(2) The "Evening Star," Dunedin, location of Station 4YA.

(3) 3YA as viewed from Latimer Square.

(4) A corner of the artistically furnished studio at 1YA.

(5) Panorama of the Grand Studio at 2YA, Wellington, the largest of the numerous studios. All are handsomely furnished in blue and gold. Note the padded panels in the walls.

(6) On the isolated and rocky spur of Mount Victoria, two and a-half miles from the studio, is the 2YA transmitting station whence untrammelled by man-made structures of a busy city, the radio waves from this powerful station sweep New Zealand and across the Pacific Ocean bringing entertainment to thousands of listeners. The aerial is 750 feet above sea level.

(7) A corner of the studio at 3YA. Rose pink chenille curtains drape the walls.

(8)The well-appointed main studio of 4YA.

(9) The 500 watt transmitter at 4YA. Similar plants are installed at 1YA and 3YA.

(10) The powerful transmitter of 2YA, 5000 watts, rated on the input to the aerial, making it one of the most powerful transmitting plants in the British Empire.

(11) Interior view of the administration offices at Christchurch.

THE SUPPLYING OF A BROADCASTING SERVICE

WITH SPECIAL REFERENCE TO THE R.B.C. OF N.Z.

IT is superfluous to talk to radio listeners about what a great thing radio broadcasting is. Its lure is an all-encompassing net into which are gathered the crystal set user, the valve set man, the D-Xer whose ideal is to hear overseas stations, the man who wants only sporting news, the farmer to whom stock sale reports are of paramount importance, those who want "high brow" concerts and less jazz, those who want more jazz and less classical, those who think there are not enough talks and those who think there are too many—in short, as many tastes as there are listeners, all grumbling but all satisfied, all getting more broadcasting than they expect, but all wanting more, yet all admitting that radio broadcasting is the greatest thing that science has brought into their lives. Is it not really a great privilege that, no matter where you may live, in mansion or in cottage, in town or in country, the whole world should be brought to your fireside? When you sit down and soberly consider the things that make life worth living, radio with its vast store of entertainment is certainly one of them.

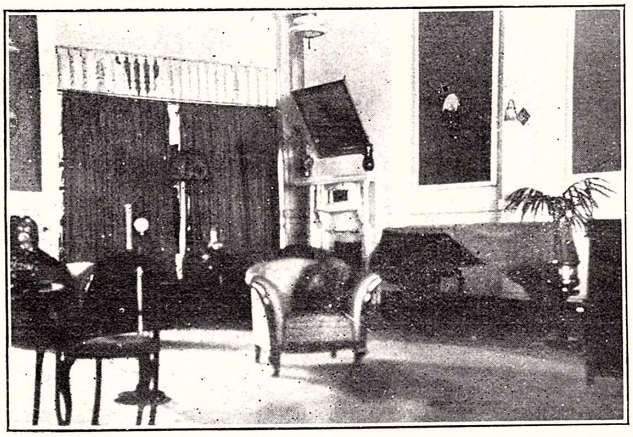
Like the motor, a mechanical instrument that serves men badly and well, the radio is an accomplished fact. It has, for good or bad, come to stay. As a force in our daily life radio occupies our attention more hours daily than the telephone or the newspaper. We have only to glance at the radio page of any newspaper to see how much radio entertainment is offered daily to fill this need. The number and variety of items from the various stations day after day, week after week, are bewildering.

These modern times, with so many outdoor attractions, home entertainment is a problem. What with dancing halls, cabarets, talking pictures, motor cars, etc., it is difficult for those who desire to spend some of their time at home to do so without perhaps a slight degree of boredom. This particularly applies to the younger generation. Radio, however, of recent years has gone a long way towards solving the problems of entertainment in the home. With the great variety of programmes now available to listeners-in, there is no need to go short of either musical entertainment of interesting, up-to-the-minute news. Many functions and happenings can be listened to with much greater comfort than would be possible at the actual location of the event.

When we consider the immense strides radio has taken in the last three years—on the mechanical side as well as in the quality of programmes constantly given—the optimist can sit back somewhat more than satisfied. About 60,000 sets now carry these programmes into as many homes in New Zealand, and saturation point has not been reached yet.

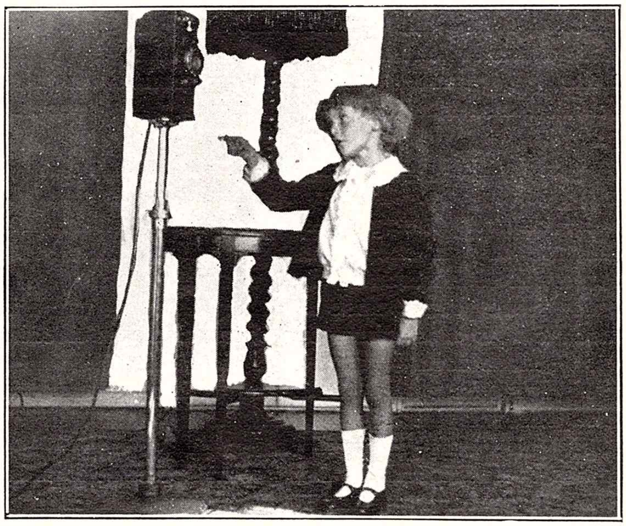
Radio has passed its period of infancy. It is fast growing up. To-day radio shows, as does the adolescent boy, long awkward arms and legs, but, like the boy, it shows much promise. It already has much to its credit. But, again, like the boy, it needs some pretty close watching and no little correction. As a medium of communication nothing has been devised by man that is more universal or more immediate than the radio. It is a wonder that stirs the imagination and thrills when, from the other side of the world, something exceptional comes over the ether. But natural science is piling wonders so rapidly that we quickly accept marvellous inventions as matters of fact.

Human nature is peculiarly quick to adapt itself to new conditions, and this characteristic is responsible for the ease with which we can become accustomed to and take for granted innovations which are the product of scientific development. As time goes on there is an inclination to forget that we were ever without broadcasting and to look upon it as one of the common amenities of life, meriting no more special consideration than electric light or the telephone, but in the comparatively short space of eight years which it has taken to build up broadcasting organisations throughout the civilised world, broadcasting has undoubtedly contributed very effectively towards general pro-



A corner of the main studio of 2YA, Wellington.

gress. Broadcasting has found its greatest sphere of usefulness in providing recreation and both musical and general education amongst very large sections of the public, who, either because of their geographical location or for financial reasons, would otherwise be denied these amenities. The distribution of general knowledge for which broadcasting can be held directly responsible is a most important part of its service to mankind.



A juvenile entertainer during the Children's Session. Much excellent talent performs before the microphone.

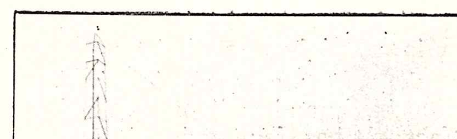
Broadcasting is now a very vital factor in the life of the community. It reaches the people in their homes; it brings to the humblest domestic fireside entertainment and information. With the expansion of the roll of listeners, the service given by the Broadcasting Company has improved and will continue to improve. Its news sessions in the early evenings tell of all the recorded happenings of civic and national importance, the movements of shipping, the prices of live stock at the sales, the latest exchange quotations, the weather reports, all of which are attentively listened to by the dweller in the city as well as by the country settler. We in New Zealand have heard the striking of Big Ben in London, listened in on historic events and heard the voices of famous men whom we would never hear in any other way and whom we now think we know personally.

An aspect of broadcasting activity, the influence of which has only begun to be widely felt during the past two or three years, is the happier relations and closer sympathy which are steadily growing up between the peoples of different countries as a direct result of mutual participation in broadcasting programmes. The evening with the family listeners to a musical entertainment emanating from an overseas station can do more to break down artificial barriers of nationality than many years of diplomatic tact and political manoeuvring.

The task of the R.B.C. as universal entertainer is, as even the most ungracious listener will admit, no light one. It is rendered more difficult by uncertainty as to the tastes and requirements of the entertained. To ascertain the likes and dislikes of 250,000 listeners would be a task or Hercules, but even supposing such acts could be discovered by some gigantic form of referendum it would still remain for the R.B.C. to strike a mean between them and so devise programmes which, taking account of all circumstances would be generally satisfactory. Admittedly there is a divergence in tastes and these also vary from day to day with the changing moods to which all humanity is prone.

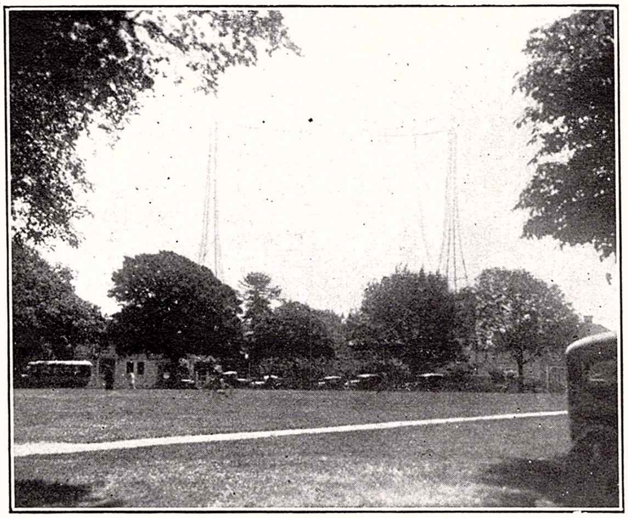
It was with the view to catering for the diverse tastes of listeners and providing as much variety as possible in the broadcast entertainments that a schedule was drawn up allocating to each of the four stations a distinct type of programme for each evening of the week. As far as possible it was arranged that no two stations would be broadcasting the same type of programme on the same evening. By following out this schedule, or rota, listeners throughout New Zealand have the choice of several programmes and can tune in to whichever one their taste or fancy pleases.

Pursuing a well thought out plan to introduce as much variety as possible into the musical portion of the programmes, the Broadcasting Company set



The transmitting station of 2YA, Wellington, on Mt. Victoria, 2½ miles from the studios, which are in the city. The aerial is 750 feet above sea level.

to work to engage all the best available vocal artists in each of the cities and these were, where possible, formed into quartets in order that they might rehearse concerted work. This policy has proved very acceptable to listeners. Some of these



A pretty glimpse of the towers of 3YA, Christchurch, as viewed from Latimer Square.

quartets formed nearly three years ago, are still heard at regular intervals and are still very popular. In other quartets the personnel has undergone changes, but the policy holds good. These artists, being the pick of the local talent, not only have the most extensive repertoires but are proficient in quickly learning new works, whereas the repertoire of the casual performer is usually very limited. Of course, new performers of merit are always welcomed, particularly if they can present new numbers, and they are continually being added to the roll of artists.

On the instrumental side of the programme, so far as local performers are concerned, again the best available artists are engaged for solo, trio and orchestral work. By arrangement with the various local musical societies, too, the Broadcasting Company, with the view to encouraging local talent, pays regular subsidies in return for which the societies permit their public concerts to be broadcast or alternatively, under certain circumstances, they give performances in the studios. The societies which come under this subsidy scheme have found that the broadcasts have not adversely affected the attendance of the public at their concerts, while the subsidy received has had an important bearing on the nature of their annual Balance Sheets.

Apart from the local musical talent, both vocal and instrumental, which is utilised to the fullest extent possible, a very important section of the service is supplied by gramophone records. Performances by the world's best artists of all kinds are thus made available to the people of New Zealand to an extent not possible by any other means than broadcasting.

There is no longer any question of the amount or quality of music offered on the better programmes. The question is rather, Aren't we hearing too much music? It is possible more good music is on the air each week than can profitably be heard by anyone. And the higher the quality of music, the sooner we come to the point of diminishing returns from such music. We can certainly have too much of music, even when we really listen to it. And if we listen carelessly or let music serve as a background it ceases to serve its artistic purpose. Nothing will kill good music more quickly than treating it with indifference—a condition that easily arises if we hear too frequently even the best works.

It is only by hearing again and again the greatest works that their deepest beauties begin to unfold. So many persons have been frightened away from "symphonies" in the past unnecessarily, they are now finding out. Some of these works are not at all terrifying and some, these people are now learning with surprise, are rather pleasant to listen to. The general suspicion long entertained in musical circles that the larger orchestral works of Beethoven, Strauss, Wagner, Tschaikowsky and many others, were really quite worth listening to is coming to be shared by a very large number that never saw a symphony orchestra. At the same time there is the danger that the public is likely to get too much music. More first-class music has been on the air so far this season than one could have

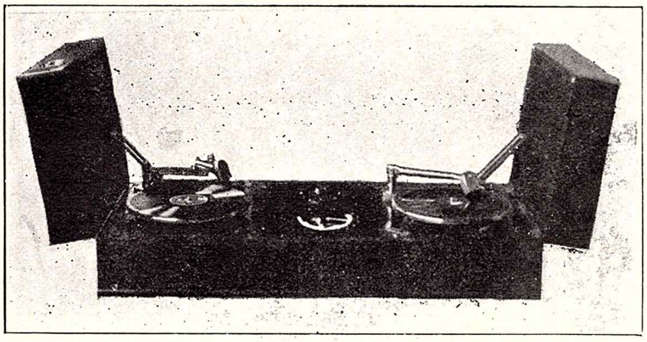
Portion of the record library at the Administration Office, Christchurch. Before finding a place on the shelves, every record is carefully tested and card-indexed. The gramophone equipment for electrically reproducing the recordings is to be seen at the left of the picture. The examiner is using headphones.

heard in a whole season 10 or 15 years ago in the concert halls of London.

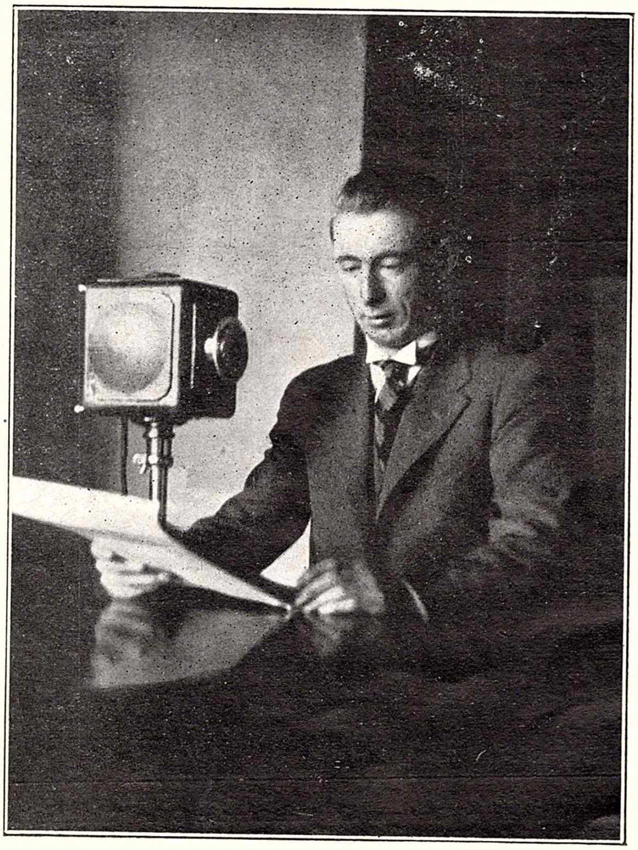
Apropos to the foregoing, another aspect is the problem which faces broadcasting stations, particularly those which have a limited amount of talent at their disposal. This is the question as to whether or not they should accede to a popular demand to extend the hours of transmission, and water down the standard of the programmes accordingly, or maintain the quality of their concert programmes at the highest level possible. The British Broadcasting Corporation has its troubles and critics the same as any other radio broadcasting concern, though it has a revenue of approximately £1,000,000 a year and almost unlimited talent at its disposal.

A great wealth of diversified entertainment and educational features is now available daily to the public through the broadcasting stations in New Zealand. Though entertainment is the basis—and many people think it the sole purpose of a broadcasting service—that is not the aim or the ideal of the R.B.C. The service provided by the Radio Broadcasting Company caters for people in every walk of life and every interest.

Because entertainment is liberally provided for them, many people entertain the idea that the supplying of popular entertainment is the sole function of the broadcast service. Such, however, is by no means the case. Broadcasting in New Zealand is now firmly and permanently entrenched as a great community service. To be so recognised, any service must prove itself really helpful in promoting the well-being of the people. Herein is the predominant function of a truly national broadcast service. It must provide entertainment, and provide it generously, as the New Zealand service does, but above all it must keep its listeners in touch with world, national, and civic happenings; keep them informed as to everything that matters in every sphere of our national life; provide them with useful advice and instruction. It must, indeed prove itself a veritable friend and helpmeet as well as a pleasing entertainer. Looking back over the past year or so, New Zealand listeners will recall many outstanding broadcasts of important public functions and events of world-wide, national, and civic interest, including numerous relays from all parts of the Dominion. These special broadcasts, with their great diversity of location and interest, typify the wide catholicity and extraordinary utility of our Radio Service.



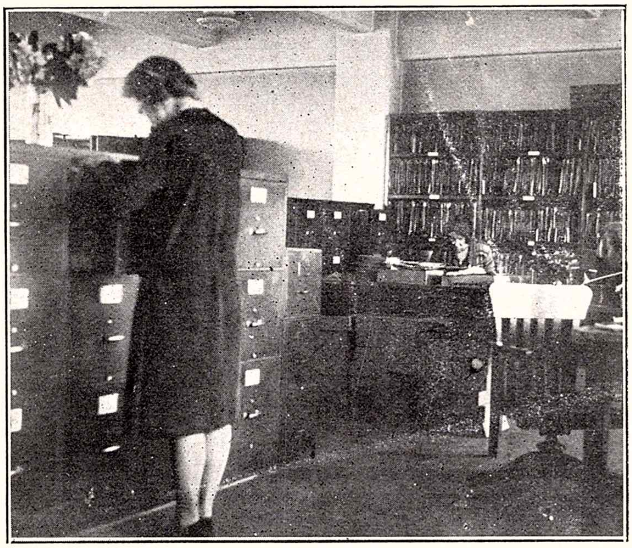
Twin turntables are used at all stations for electrically reproducing the gramophone records. The central switch (seen in the white semicircle) and the use of two records enables a lengthy piece to be produced without any appreciable break between the recordings.



An announcer—this is Mr. A. L. Curry, of 3YA—at work before a microphone.

Is there any type of retailer who gives the consumer more for his money than does the radio dealer? For the price of a few months' desultory entertainment of the ordinary type the buyer of a radio set gets the best in music, speech, and drama for his home over the many years' service a good radio will give. The cost, therefore, of this splendid entertainment is ridiculously low. To no section of the community is a radio service of more value than to people on the land. Up to the advent of radio broadcasting isolation and loneliness were the two chief handicaps to rural life. This is, however, now a thing of the past, or it should be, for, apart from bringing to the outback farmer the amenities of civilization so far as music and other entertainments are concerned, it brings to him the world's news, and particularly the news from the stock markets. To the farmer there is

nothing more valuable than the market reports; and in nothing is it more essential that the information should be reliable. The farmer must be able to place the implicit faith in the accuracy of the information that is broadcast. From the very outset the Broadcasting Company has been keenly alive to the importance of authentic reports, and prides itself that the reliability of the firms who supply the various markets reviews is unimpeachable.



The large music library at the Administrative Offices, Christchurch, is housed in steel filing cabinets, every drawer of which is carefully card-indexed. All the stations are supplied with music from this central library.

Apart from the news value of the service in this respect, systematised talks for the benefit of the man on the land are a regular feature of the programmes between the hours of 7 and 8 o'clock. This to the farmer is an "extra" to the usual service. There is, besides, the whole range of interesting features which appeal to townsman and countryman—the entertainment brought by broadcasting to the fireside—the news of the day, sporting results, the weather forecasts, the correct time, etc., etc. He, too, can enjoy the dinner music session and the concert programmes. The broadcast service appeals also to the woman on the land for she too, like the town housewife, can profit by the weekly home science talks, and the children on the farms share in the pleasures of the children's session. This is all practical broadcasting. the result of which must be for individual and national benefit.

No account of broadcasting in New Zealand would be complete without reference to the children's sessions. This is one of the most important branches of the service. In that hour "between the dark and the daylight," when radio aunts and radio uncles, or whatever may be their radio appellation, perform their labour of love, a beneficial influence, in the form of healthful entertainment, is broadcast over the Dominion. No one can estimate the effect of this service for children. With so many thousands of children listening in every night, broadcasting can work for weal or woe; it is such a wonderful power. But the greatest care possible is taken to see that nothing harmful is sent out—only that which is good.

But that principle is applied to the whole broadcasting service in New Zealand. There is a striking similarity in the principles underlying the policy of the Radio Broadcasting Corporation. The B.B.C. explains its policy as follows: The aims of the B.B.C. are to provide a series of programmes, each of which is good of its kind, and as efficient in its handling as talent and careful rehearsal can make it. To arrange these programmes in a way that will reflect the preferences of the majority of listeners, and will make it possible for listeners to choose the programmes they want, and to adopt every practicable programme suggestion which has positive interest. On the other side of the microphone the listener must realise that a definite obligation rests on him to choose intelligently from the programme offered to him. Every listener should be his own programme builder.

When looking forward in an effort to visualise the prospects of radio broadcasting in New Zealand it is very profitable to look back at the period through which broadcasting has passed since the day when the Government, in authorising the formation of the Radio Broadcasting Company to

"The chimes of 3YA." Hymn tunes are played on this vibraphone every Sunday evening and the sweetness of the bell-like notes is greatly enjoyed by listeners throughout New Zealand. The effect is secured by electricity which rotates a metal disc between slat on the top of the instrument and the pipe immediately beneath it.

undertake broadcasting in this Dominion, made a decisive move which immediately evolved order out of the chaos then existing and laid the foundation for a national service which has continued to progress and expand in scope and usefulness. New Zealand was in the fortunate position of being able to take advantage of the experience of other countries and after considering the good and the bad features of the systems of control followed in other parts of the world the Government of the day decided that the most satisfactory method for New Zealand would be control by a private company operating under Government regulations.

The organised development of radio broadcasting in New Zealand dates back only to 1924-1925, when the Rt. Honourable J. G. Coates, Postmaster-General and Minister of Telegraphs, and later Prime Minister of New Zealand, introduced and sponsored legislation covering rigid control of radio broadcasting in this Dominion. The legislation empowered the Government to enter into an agreement for the development of broadcasting under private enterprise and Government regulation. The Act also introduced the principle of licensing listeners by a payment of a fee.

On July 18th, 1925, an agreement was entered into with Mr. William Goodfellow and Mr. Ambrose Reeves Harris for the formation of a company to undertake a broadcasting service. The following month, August 22nd, the Radio Broadcasting Company was incorporated. The three directors are: Mr. William Goodfellow Mr. Arnaud McKellar and Mr. A. R. Harris, with Mr. Goodfellow as chairman, and Mr. Harris as general manager.

When the charter was granted to the Broadcasting Company to supply a service to the people of New Zealand, certain conditions were laid down both in regard to the stations to be erected and in regard to the service to be supplied. In all respects the Government's requirements have been more than fulfilled.

The ramifications of the Radio Broadcasting Company's service embrace every walk of life and every interest. The service is a national one, and nothing that pertains to the life of the people is foreign to it. It seeks to cater for all sections of the community fearlessly and impartially. Its policy is dictated by no vested interests. It knows neither creed nor faction. Its attitude towards religion is one of reverence but of strict impartiality.

Controlling the New Zealand service and ensuring ease and efficiency in running, is an intricate and comprehensive organisation, the extent of which the public has no conception. The Broadcasting Company operates four stations, each worked as a separate unit but responsible to the central administration office. Station routine, the arranging of programmes, a vast amount of correspondence, listeners' reports which have to be carefully analysed, and the keeping and checking of logs, all require methodical handling.

Apart from the internal organisation which is so essential in the carrying out of the service, there are other aspects of organisation which have meant much for the success of broadcasting in New Zealand. Under this heading come the system of Honorary Official Listeners, who are located throughout New Zealand, and the formation of the various advisory committees—Church, Music and Dramatic, Children's Session, and Primary Productions Committees. These committees have proved a very useful connecting link between the Broadcasting Company and the public. They meet regularly to discuss the aspect of broadcasting which concerns them and they make recommendations to the company. The Honorary Official Listeners forward regular reports on the programmes and on the quality of the transmissions, and the service that is being rendered by these committees is excellent.

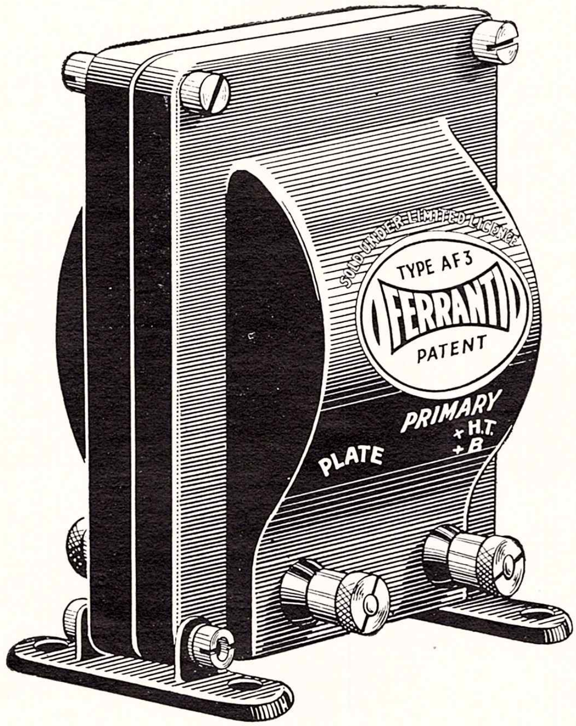
WHEN TO CHARGE

Don't let Your Accumulator Run Right Down, or You May Ruin It.

IT is not an easy matter if you do not possess a voltmeter to tell when your low-tension accumulator requires recharging. But if you are to keep it up to scratch, and so get the maximum life from it, it is very important that you do not over-charge it. Many people use an accumulator until it is absolutely run right down and will not even produce a feeble whisper from the set. This is the quickest way to ruin the cells of an accumulator.

When an accumulator is discharged its voltage begins to drop very quickly, so that hardly any extra running time is gained by over-discharging it. The voltage to which it is usually permisible to drop each cell is 1.8, and down to this value you will not notice any appreciable falling off in volume from the receiver. But as soon as the voltage goes below, you will find results getting weaker and weaker, and this should be your signal immediately to disconnect the L.T. accumulator and have it charged. Do not wait until results fade right away.

An even more sensitive indication that it is charging time may be obtained from the reaction control. As soon as the accumulator voltage drops even a little you will find that the reaction condenser has to be turned further round, to give the same effect as usual.



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Peeps Inside ZL2XP

A NEW ZEALAND RESEARCH STATION

THE transmitting callsign ZL 2 XP is one which is not very freqeuntly heard "on the air", but this fact is in no sense an indication of inactivity, but rather the reverse. In fact, this transmitting station is rather unique in that its successes are not measured in terms of "DX" or a long list of stations worked, but are indicated in numerous graphical records of test measurements and results. It is here that the well known Philips transmitting valves are put through their paces, though this by no means represents the full activities of the station. The owner of the station is Mr. W. M. Dawson, Chief Engineer of the Philips Organisation in New Zealand, and one time Technical Editor of "New Zealand Radio", and through his courtesy we are able to present to our readers views and details of this interesting station.

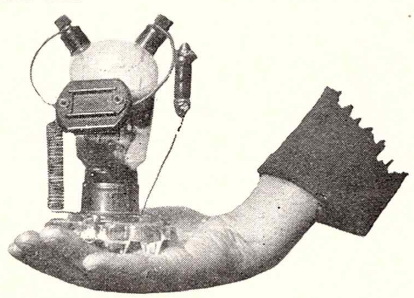


Fig. 1 A 130,000,000 cycle transmitter (2.39 metres). The plate inductance is the curved wire at left top—the grid inductance at the right. The coil at the left is the R.F. Choke.

ZL 2 XP, remarked Mr. Dawson, showing us in, is essentially different from my last transmitting station (3AL) where the thrills of making foreign contacts for the first time on very low powers rather outweighed the claims of serious research; here, the primary object of the station is the study and measurement of the peculiar phenomena and problems associated with shortwave radio transmission and reception, and the actual "working" of distant stations is quite a secondary consideration.

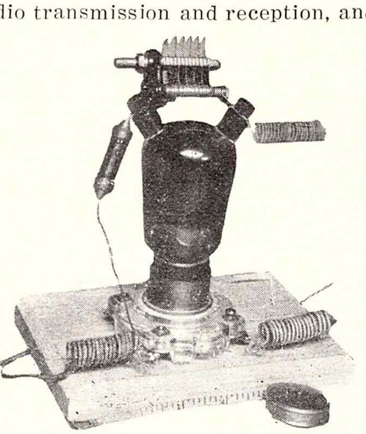


Fig. 2 This transmitter operates on a frequency of 212,660,000 cycles per second! (1.406 metres). It is complete but for A & B power supplies. The 3 coils shown are R.F. chokes.

"How then do you obtain this data if you don't transmit often? ' we asked. The reply was to the effect that transmissions were frequent enough, but very few of them were allowed to be radiated over the air.

"You see," continued Mr. Dawson, with a smile, "many of these transmissions are of such a nature that they would cause needless interference if radiated out into space, and besides, much more useful information can be obtained by absorbing the energy in a "dummy" aerial in which measurements can be much more readily made, and the constants of which can be varied at will exactly to duplicate the behaviour of a real radiating aerial. For example, one of the problems of short wave telephony (and telegraphy) is the attainment of the necessary degree of wavelength stability. If the transmitted wavelength is not held constant within very close limits, serious distortion occurs and speech and music become unnatural and less intelligible. Unfortunately, alterations in plate voltage alter the internal capacity of a valve, and this change adds to or subtracts from the tuning condenser capacity and so varies the actual wavelength transmitted. As the transmission of speech and music is dependent upon rapidly changing plate voltages, and as for modern transmitters, this voltage must vary largely (between zero and normal for 100 per cent. modulation.) the problem becomes a very serious one on the short waves.

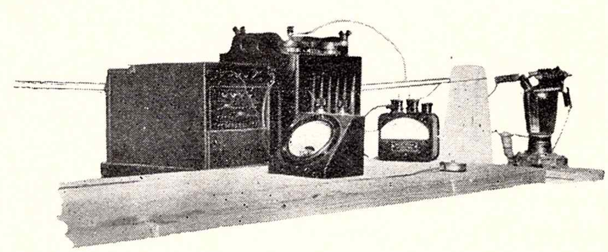


Fig. 3. One of the "wavemeters" used at ZL2XP. The transmitter under measurement is at extreme right. Accurate measurement of wavelengths to a few centimetres are practicable.

"Modern practice decrees the use of a quartz disc to control the transmitted wavelength and we even go to the trouble of keeping this "crystal" and the valve it controls inside and electrical oven, the temperature of which is automatically governed within close limits. Even such an elaborate scheme has its drawbacks, however and becomes less effective as the wavelengths are still further reduced. The wavelength at which a quartz crystal oscillates has a definite mathmatical relation to its thickness, and if we grind a crystal down very thin, to make it function on very short wavelengths, it becomes very fragile, and fractures in use. Therefore, for very short wave working, a higher wavelength cystal is used, and this is followed by amplifying stages which

double or treble the frequency until it reaches the desired transmission wavelength. Unfortunately, every "doubler" stage doubles the original frequency shift, so that, for extremely short waves, satisfactory crystal control becomes difficult and very expensive. The Philips Laboratories have, however, recently developed some new transmitting valves which help out this problem considerably.

"This," said Mr. Dawson, picking up the apparatus shown in our Fig. 1 "is a complete transmitter, except for the A and B batteries which connect directly to the valve socket terminals, and it operates with good ability on a wavelength of 2.29 metres without resorting to crystal control."

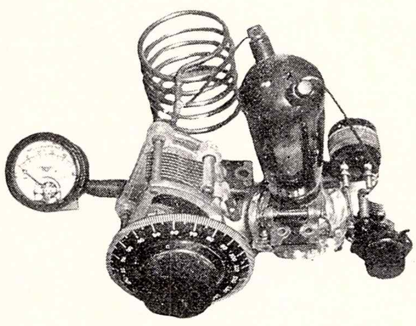


Fig. 4 Another ZL 2 XP transmitter, this time operating on the 80, 40, 20, 10 metre bands. It uses the new TC 04/10 in a Tuned Grid tuned plate circuit.

We observed that this was pretty high frequency working which brought the reply: "Well, getting high" just over 130,000,000 cycles per second, actually, but of course we can go considerably higher than that. For instance, the regular operating wavelength of this little chap (shown in Fig. 2) is 1,406 metres! Expressed in terms of frequency, this representing some 212,660,000 complete waves radiated per second."

"If you got much higher in frequency," we facetiously remarked, "you would have rather a job counting them as they passed."

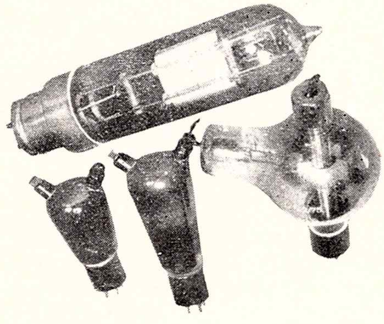


Fig. 5 Some of the new Philips Valves now being put through their paces. At the top the TB 1/50. At the left the TC 03/5. Bottom centre TC 04/10. Bottom right, the QB 2/75 screened grid transmitter.

"Well, no," was the answer, "we could readily tally them up accurately at a considerably greater frequency, in fact, when expressed in terms of wavelengths in metres, the accuracy of our measurements here is to the third decimal point—i.e., right down to millimetres, the above wavelength being 1 metre 406 millimetres. This is the actual wavemeter, here, indicating the apparatus (shown in our Fig. 3) an application of the Lecher wire principle. Two parallel wires a few inches apart are energised from the transmitter and as we slide a current indicating device (a thermogalvanometer) very slowly, we reach a point where maimum current flows in the meter. Marking this place accurately, we proceed further along the wire, until the meter again registers a maximum. These points are exactly half a wavelength

Mr. Dawson then demonstrated the extreme sharpness of the positions found; subsituting the thermo couple meter with a piece of 18 gauge bare copper wire, it was seen that the slightest twist of the wire in the fingers causing it to roll very slightly along the stretched wires affected the meter readings considerably, and that the peak was extremely sharply defined. It was further demonstrated that the hand or body could approach within a few inches of the transmitter without varying the wavelength. A year ago with 5 metre experiments, the operator could not move about the room without causing serious shift of the transmitted wavelength. Now, with the help of these newly developed Philips valves, much shorter waves may be produced with excellent stability.

"Is any practical use being made of these ultra high frequencies?" we asked.

"At present no regular commercial transmission schedules are using them, but when we find out more about their behaviour, we will no doubt be able to make effective use of them. Apart from that, ultra high frequency working serves much the same purpose as motor car apart, and accurate measurement in metres, doubled up, gives the wavelength. Relatively simple after all, isn't it?' —We agreed.

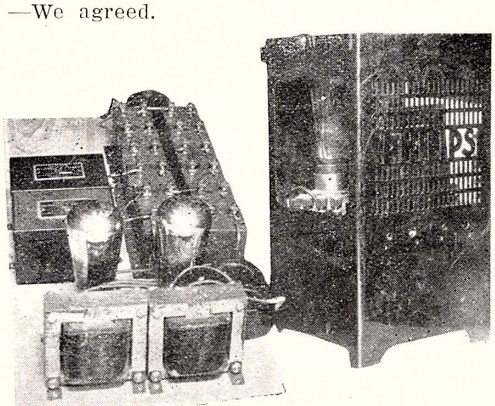


Fig. 6 Two of the several power supplies used. At the right. a complete 1000 volt power pack—formerly a battery charger At left a well filtered 350 volt supply.

racing does to a progressive car manufacturer—the conditions are severe, and a valve that functions satisfactorily on very short waves is an excellent valve on normal waves. The valves used in these two transmitters are the TC 03/5 which is a most excellent valve for general amateur use, its filament requirements are amazingly small—only 4 volts .275 amperes, so that it can be run from the receiver accumulator without undue drain. This makes it easier to get a good "note" on very short wavelengths, it is very easy to handle, and operates with high efficiency and remarkable stability. Its bigger brother is the TC 04/10 (shown in use in the transmitter of Fig. 4). Its performance on the very short waves is equally outstanding, though in this case it is in use

on the 40 metre band where for the past few weeks it has been putting good rock steady D.C. signals all over New Zealand at a fraction of it full power. Nominally rated as a 10 watt valve it is the ideal amateur transmitting valve designed for 400 volts on the plate, and properly handled it will land shortwave signals into any corner of the globe."

We picked up another T shaped valve—this turned out to be a new Philips 75 watt screened grid transmitting valve. Intended primarily for use in the buffer stage of a master oscillator power amplifier type of transmitter it has, on account of its extremely low inter-element capacity, a special appeal as a stable short wavelength oscillator, and tests in this direction at ZL 2 XP have shown it also to be an excellent valve for amateur use.

"Might we have some photographs of the station? '

"Certainly, just a moment,"—and our host reappeared armed with a camera, and flashlight powder. The necessary photographs were quickly taken.

"Now before we go, have you any message for those contemplating taking up radio transmission?"

"Yes! Tell them that they will receive from it many times the enjoyment that they get from merely listening—that the equipment required need not be elaborate or expensive, nor difficult to operate, that the thrills of making first contacts with distant stations must be experienced to be believed—of the camaraderie of the air. Unfortunately, the average beginner starts wrongly by using a general purpose receiving valve, and then proceeds to abuse it by crowding more and more voltage on it until the transmission becomes wobbly, and of poor tone, due to the valve becoming overheated. Fortunately the advent of the new TC 03/5 at a very reasonable price practically solves this difficulty,, and the beginner is strongly recommended to make his start with such a valve as this, or the TC 04/10. The transmitter shown in Fig. 4 is an excellent type for beginner or experienced amateur alike. It is as inexpensive as a reliable transmitter can be; very efficient, and extremely easy to adjust to produce a clean penetrating signal, of which the originator will be proud. It is very much easier to read even a very weak signal of this type, than an enormously loud signal with a rough note. and with a wobble. Both the plate and grid circuits are tuned, and this makes for stability and gives full control over the excitation of the tube. The large condenser in the centre of the reproduction is the plate tuning one—a good receiving variable does nicely, and the copper tube helix just behind it is the plate coil. The grid circuit is tuned by the midget condenser at the extreme right, the grid coil being clearly shown to the right of the valve. Both coils are made "plug in" so that the transmitter can be adjusted for the 80, 40, 20 or 10 metre bands in a few seconds.

"Note that the whole transmitter is rigidly wired up and all essential leads short but well spaced. A single meter is all that is really necessary—it is of course placed in the B positive lead, the plate current then flowing through the circular radio frequency choke shown between the meter and the plate condenser. It is thus no more elaborate or expensive than a good single valve receiver. An important point in adjustment, and a point which the beginner usually ignores is not to adjust the transmitter to squeeze the greatest possible output from it, but always work well below this adjustment when the quality of the signal will be much superior and much more readable at a distant point. It is not so much a matter of how much power you radiate, but the quality of signal and reasonably careful adjustment of the above transmitter and valve can produce a signal which is usually as "pure D.C. crystal control" and which cannot be better by the most elaborate transmitter designed."

Any of your readers contemplating transmitting activities may have detailed specifications of the above transmitter on application to Philips Lamps (N.Z.) Ltd. There were many other interesting things to be seen at ZL 2 XP but we had gathered ample material for our article, and with regrets we bade our host farewell, and wished his station every success in the other researches which are being carried out at the present time.

AN IMPROVED FRAME TRANSFORMER

SOME portable sets are sent out by the makers with terminals or other points of connection for aerial and earth, while others have no such provision for extending their range of reception or overcoming the disadvantages of a "blind spot." With the latter type of set the user is often at a loss to know how to attach an aerial for temporary purposes and the following notes may be of interest.

A Primary Winding for the Frame.

The simplest and most universal means of overcoming the difficulty lies in converting the frame aerial of the set into the tuned secondary of a transformer, by providing a primary winding to which aerial and earth can be attached. This can be done by putting outside the case, over the frame, from one to three turns for the short-wave, and perhaps ten for the long-wave stations. The number of turns will have to be chosen to suit the peculiarities of the set in use, the number being kept small if selectivity with more turns is too poor. If the set has but one tuning control, even a one-turn primary many reduce selectivity to such an extent that the local station is heard "all over the dial." The addition of the aerial will, in such a case, confer no useful extra range whatsoever.

A Separate Frame.

To meet such a state of affairs, the primary may be converted into a loosely coupled tuned circuit. For this ,the turns must be increased to ten or a dozen on a framework separate from the set, but roughly equal to its dimensions. The station required is then tuned in on the portable by itself, and the new frame, with aerial and earth connected, is set up some feet from the set and parallel to the frame in the latter. On tuning the new frame with a condenser the station it is desired to hear will suddenly appear at good strength, while the local station will produce hardly more background than with the areial out of use, and certainly much less in proportion to the wanted programme. By juggling with the relative positions of the set and the added coil a good deal of control over selectivity may be had, and the portable set may be given, in this wayfi a sphere of utility far greater than its makers intended it to possess.

TECHNICAL SECTION

AERIAL SYSTEMS

THE installation of an aerial system for the reception of broadcasting is usually a matter of finding the best possible compromise between theoretical laws on the one hand and the practical potentialities of the space and height available on the other Some remarks concerning the installation of aerial systems may, therefore, be of assistance.

If an increase in the sensitivity of the receiver is desired, it is always advisable to consider whether it can be brought about more economically and conveniently by an improvement of the aerial system or by an increase in the sensitivity of the receiver. For example, crystal-set users, in certain circumstances, may find it cheaper to use a one-valve receiver, continuing with the use of their old headphones, than to install a sufficiently satsisfactory aerial to enable reception to be carried out on a crystal set.

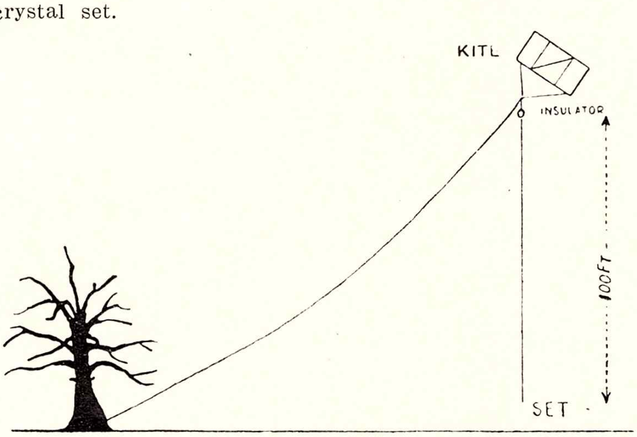


FIG. 1a

Types of Aerial

The most efficient aerial arrangement, from the point of view of its ability to pick up the maximum amount of energy, is a vertical wire suspended so that it hangs well clear of any material which is in contact with earth. In general, an endeavour should be made to obtain the maximum average height for the length of aerial wire which is being used. In Fig. 1, three types of aerial are shown, all consisting of 100 feet of wire. The average height of the aerial shown in Fig. 1a is 50 ft.; of that in Fig. 1b 32 ft., and of that in Fig. 1c 25.5 ft. It will be seen at once that the vertical arrangement is by far the most efficient, but as the suspension of a hundred feet of vertical wire is hardly a practical arrangement for a broadcast listener, a compromise has to be found.

In general it is not a good policy to make an aerial system inconspicuous; for example, it is bad practice to hide the horizontal portion of the aerial by running it close to the eaves or roof of the house. Although aerials of this type usually succeed in being nearly inconspicuous, they are seldom efficient, for their effective height is small. If the roof of the house is covered with iron, which is usually in electrical contact with the ground, the aerial in effect is only slightly higher than ground level. If, on the other hand, the distant or high potential end of the aerial is suspended by a mast or tree so that it runs clear of the house, conditions are vastly improved and the effective height is greatly increased. There are many type of conductor used as aerial wire, but it is unlikely that any will give better results than properly installed stranded copper or phosphor bronze wire.

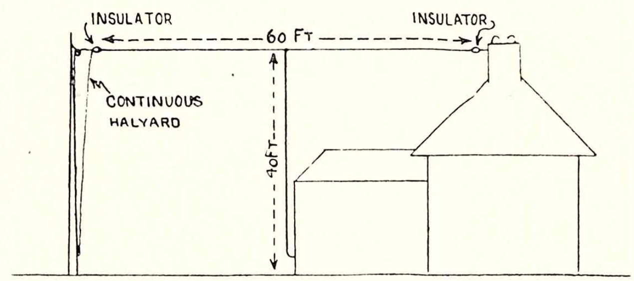


FIG. 1b

A tall tree is a perfectly satisfactory means of support for an aerial system, provided it is situated at a convenient distance from the house and gives the aerial wire a clear run. In fixing the aerial to a tree, however, it is advisable not to anchor the wire so high up the tree that it swings about unduly in the wind. Continual movement of the aerial wire is liable to break strands and depreciate any joints which exist in the aerial wire or down-lead. It is also inadvisable to run the active portion of the aerial close to ithe trunk of the tree, that is, inside the spread of the branches. This can be avoided by fixing a guy wire to the trunk of the tree and insulating the far end of the aerial from the guy wire outside the branches, as is shown in Fig. 2. Where excessive movement of the aerial due to the swaying of the tree in the wind cannot be avoided without seriously decreasing the height of the aerial, springs or balance weights can usefully be employed.

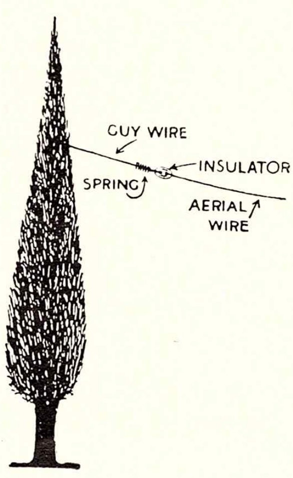


Fig. 2

If there is sufficient space available but a suitable tree or other obvious means of support does not exist, it is probable that a local wireless dealer or builder could supply and erect a wooden mast. A pulley should always be fixed on top of the mast for the convenient raising and lowering of the aerial system by means of a continuous rope halyard. When the exact position of the aerial mast has been chosen, careful measurements should be made in each direction from the foot of the mast to ensure that, should it fall, it will not cause serious damage to property or personal injury. If there is any option in the position for the mast, one should be chosen which will result in the aerial wire being at right angles rather than parallel with any other aerial wires in the immediate vicinity. It is highly advisable to employ at least one insulator at each end of the horizontal portion, even if insulated wire is used. It is not necessary, when choosing the position of an aerial, to

make arrangements so that it points towards the broadcasting transmitter which it is most frequently desired to receive. "T" or inverted "L" shaped aerials of the dimensions used by broadcast listeners seldom have marked directional properties except those due to screening by neighbouring buildings or trees, which impede the passage of the ether waves to an indefinite extent.

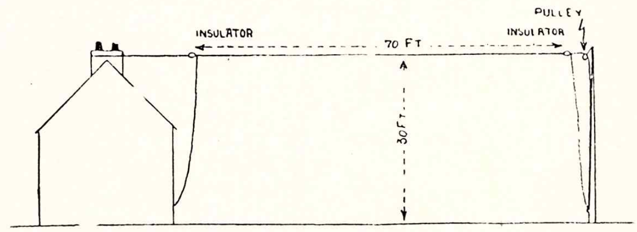


FIG. 1C

The Down-Lead

After the maximum height has been obtained, attention should be paid to the down-lead. Matters should be so arranged that the down-lead comes away clearly from the aerial wire, as is shown in Fig. 1c, without being doubled back on it. If the natural position of the aerial wire does not allow the down-lead to come unobstructed to the point at which it is lead through the wall of the house to the receiver, it is possible to use one or more

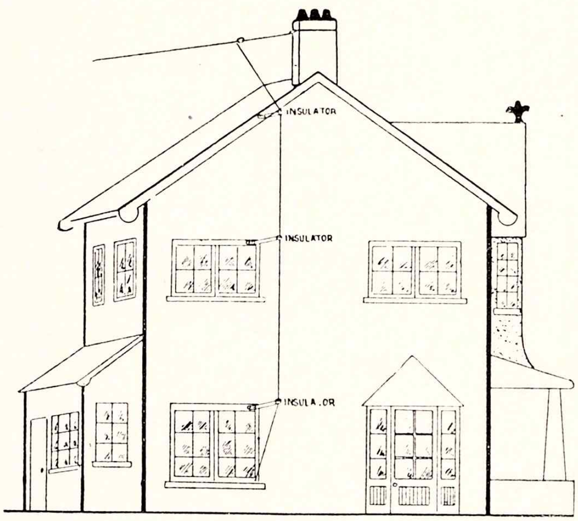


Fig. 3

spacing rods fixed horizontally to the roof or an upper window-sill. These spacing-pieces or jury-masts are shown in Fig. 3. Where it is possible, the down-lead should be kept at least two feet from the side of the house and should be quiet clear of any foliage. If this is done, the down-lead will play a more active part in picking up the energy from the distant broadcasting station than it would if it were run within a few inches of the side of the house.

When erecting an inverted "L" type of aerial it is better to avoid making a joint between the horizontal portion of the aerial and the down-lead. The aerial wire should be passed twice through insulator without being cut and the down-lead section tied or bound back to the horizontal portion as shown in Fig. 4. Any joint which has to be made, as, for example, in a "T" shape aerial, should be soldered. The mere twisting together of strands can easily lead to trouble, as the joint is exposed to the weather and may rapidly become a bad electrical connection.

In heating aerial wire for the making of a soldered joint, care must be taken not to susbject the wire to too great a heat, as otherwise its mechanical strength may suffer.

If the most convenient point for leading the aerial into the house does not happen to be near the position in the house where it is most frequently desired to

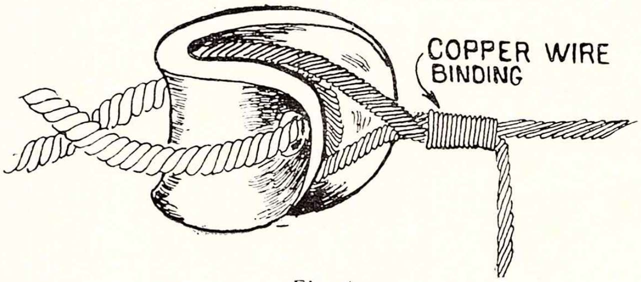


Fig. 4

listen, it is better to install the receiver near the aerial lead-in and to extend the loud-speaker or headphone leads from the receiver to the required points in the house. This is preferable to placing the receiver a long way from the aerial lead-in insulator and employing a long lead-in wire. Any necessary connecting wire between the aerial lead-in terminal and the receiver should, as far as practicable, be run clear of walls, pipes, electric mains, or other "earthy" bodies.

The Earth Lead

Space does not permit the inclusion of suggestions concerning earths and earth leads except to state that the earth should be as near the receiver as is possible and so avoid a long earth lead. If a water-pipe is employed, the earth should be fixed to it by means of a clip and not twisted loosely round the pipe. A lead cold-water pipe should be chosen for preference and should be carefully scraped or cleaned with fine emery cloth before the clip is fixed round it. The surface of the pipe should be cleaned over an area slightly larger than that occupied by the clip, so that the clip is not held away from the cleaned surface of the pipe by paint or other matter on either side.

The wire connecting the receiver to the earthing point should be at least as thick as the aerial wire, and as straight as possible.

It should be remembered that the earth lead and earth are part of the aerial system of the receiving equipment and should be treated with the same respect.

Effect of the Aerial on Selectivity

It is not always realised that an aerial system provides damping when it is connected to the tuned circuit of the receiver, and has a definite influence upon the selectivity of the equipment. The extent to which an aerial reduces the selectivity of the equipment depends largely upon the physical size of the aerial, its high-frequency resistance, and its insulation.

It is inadvisable to use a larger aerial than that necessary for the provision of sufficient strength. If the volume is more than sufficient, the aerial should be

reduced or a small condenser placed in series with it. The increase in the power of medium wavelength broadcasting transmitters will enable many listeners to reduce the size of their aerials without suffering from insufficient volume, but it is emphasised that an aerial should never be reduced unless it provides more than an adequate input to the receiver.

Maintenance

Aerial systems, including the earthing arrangements, sometimes get forgotten in the regular maintenance of receivers. It is advisable to take down the aerial once a year, and to examine the wire foot by foot for broken strands or for any cracking or loosening in soldered joints. If an aerial consists of stranded wire and one or two of the strands are broken, it is quite likely to produce crackles in reception when it is swinging about in the wind and the broken ends come into intermittent contact.

The aerial insulators should be cleaned and freed from any soot or other deposit which they may have collected, particularly in densely populated districts. A cracked insulator should, of course, be replaced.

Aerial switches, especially those which are mounted outside the house and exposed to the weather, should be removed entirely and cleaned. Any corrosion wich exists on the blades or terminal screws should be carefully scraped off and the contact cleaned with emery cloth.

If an aerial mast is used, its stays should be examined to avoid the danger of the mast falling and doing damage to property. Rope halyards particularly require attention, as it is usually far easier to splice a new halyard on to the old one and to run it through the pulley than it is to take the mast down.

Any internal wiring should also be examined and terminal nuts tightened up.

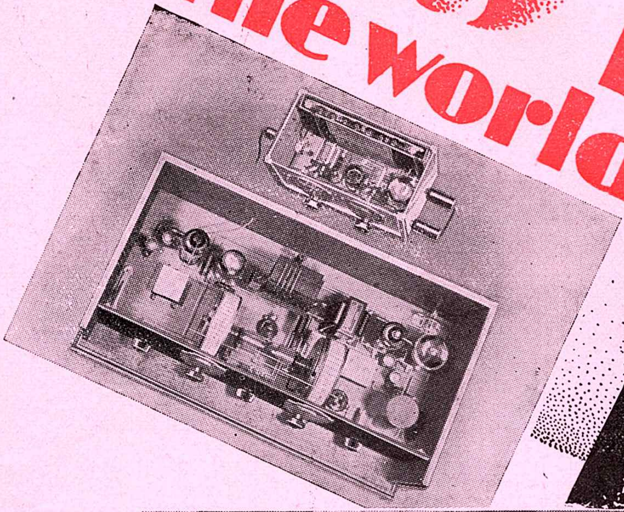
If an earth plate is used and the connection to it is underground the earth wire should be given one or two vigorous tugs to ensure that it has not corroded underground and become disconnected from the earth plate.

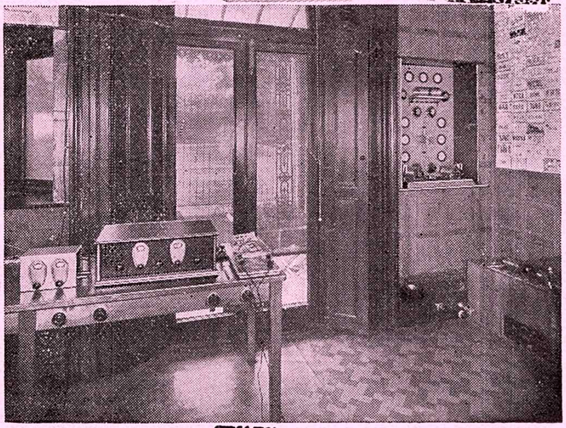
WORLD TIME CHART

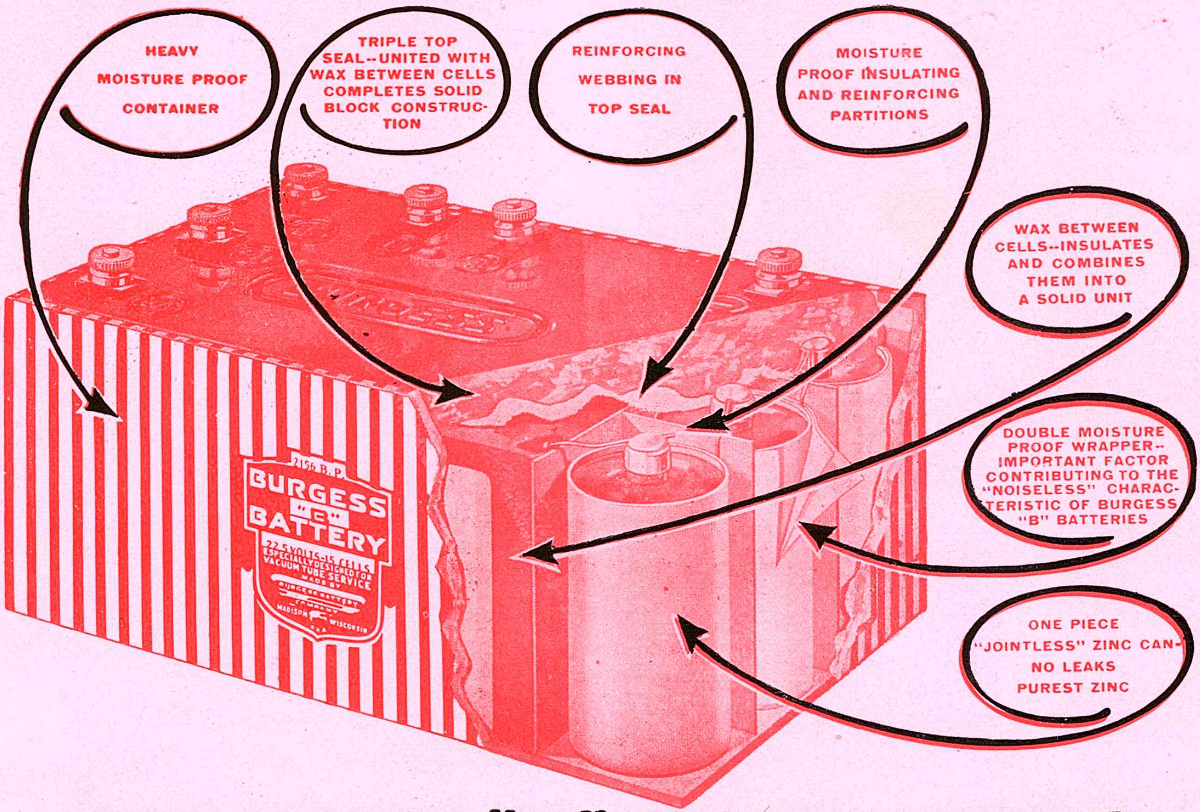
When it is NOON in New Zealand, the following are the approximate times at the places listed hereunder:—

ADEN	3.30 a.m.	GERMANY	1.30 a.m.	PANAMA	7.30 p.m.
AFRICA, SOUTH	2.30 a.m.	GIBRALTAR	12.30 a.m.	PARAGUAY	8.30 p.m.
ALASKA	2.30 p.m.	GREECE	2.30 a.m.	PERSIA	4.0 a.m.
ALBANIA	1.30 p.m.	GUAM	10.30 a.m.	PERU	7.30 p.m.
ALGERIA	12.30 a.m.	GUATAMALA	6.30 p.m.	PHILIPPINE ISLANDS	8.30 a.m.
ARGENTINA	8.30 p.m.	HAWAIIAN ISLANDS	2.0 p.m.	POLAND	1.30 a.m.
VICTORIA	10.0 a.m.	HOLLAND	12.50 a.m.	PORTUGAL	12.30 a.m.
AUSTRIA	1.30 a.m.	HONDURAS	6.30 p.m.	QUEENSLAND	10.30 a.m.
AZORES ISLANDS	10.30 p.m.	HUNGARY	1.30 a.m.	ROUMANIA	2.30 a.m.
BARBADOS	8.30 p.m.	ICELAND	11.30 p.m.	RUSSIA IN EURO[illegible]	2.30 a.m.
BELGIUM	12.30 a.m.	INDIA, CALCUTTA	6.20 a.m.	SALVADOR	6.30 p.m.
BERMUDA	8.10 p.m.	ITALY	1.30 a.m.	SCOTLAND	12.30 a.m.
BOLIVIA	8.0 p.m.	IRAQ	3.30 a.m.	SENEGAL	11.30 p.m.
BORNEO, LABUAN	7.50 a.m.	IRELAND	12.0 mid.	SHANGHAI	8.30 a.m.
BRAZIL, COASTAL	8.30 p.m.	JAMAICA	7.30 p.m.	SIAM	7.30 a.m.
BRITISH GUIANA	8.45 p.m.	JAPAN	9.30 a.m.	SIERRA LEONE	12.30 a.m.
BULGARIA	2.30 a.m.	JAVA, BATAVIA	7.50 a.m.	SINGAPORE	7.30 a.m.
BURMA	7.0 a.m.	KOREA	9.30 a.m.	SOUTH AUSTRALIA	9.30 a.m.
CEYLON	6.0 a.m.	LATVIA	2.30 a.m.	SPAIN	12.30 a.m.
CHILE	8.30 p.m.	LIBERIA	11.30 p.m.	SUMATRA	7.30 a.m.
CHINA, COASTAL	8.30 a.m.	LITHUANIA	1.30 a.m.	SWEDEN	1.30 a.m.
COCHIN CHINA	7.30 a.m.	LUXEMBURG	12.30 a.m.	SWITZERLAND	1.30 a.m.
COLOMBIA	7.30 p.m.	MADAGASCAR	3.30 a.m.	SYRIA	2.30 a.m.
COSTA RICA	6.30 p.m.	MALACCA	7.30 a.m.	TASMANIA	10.30 a.m.
CUBA	7.30 p.m.	MALTA	1.30 a.m.	TRIPOLI	1.30 a.m.
DENMARK	1.30 a.m.	MOROCCO	1.30 a.m.	TUNISIA	1.30 a.m.
DOMINICAN REPUBLIC	7.50 p.m.	MEXICO	5.30 p.m.	TURKEY	2.30 a.m.
ECUADOR	7.15 p.m.	NEWFOUNDLAND	9.0 p.m.	URUGUAY	9.0 p.m.
EGYPT	2.30 a.m.	NEW SOUTH WALES	10.30 a.m.	VENEZUELA	8.0 p.m.
ENGLAND	12.30 a.m.	NEW YORK	7.30 p.m.	WALES	12.30 a.m.
FIJI ISLANDS	12.30 p.m.	NICARAGUA	6.45 p.m.	WEST AUSTRALIA	8.0 a.m.
FINLAND	2.30 a.m.	NORWAY	1.30 a.m.	YUGOSLAVIA	1.30 a.m.
FORMOSA ISLAND	8.30 a.m.	PALESTINE	2.30 a.m	ZANZIBAR	3.0 a.m.
FRANCE	12.30 a.m.				

During April to September inclusive, advance Northern Hemisphere times one hour to allow for Summer Time. Noon in the above list applies to Winter Time in New Zealand, and the necessary allowance must be made during the New Zealand period of Summer Time.







BURGESS "B" BATTERIES

"Ask Any Radio Engineer."

"Recognised by their Stripes"
"Remembered by their Service"

BURGESS RADIO BATTERIES

THE PHYSICAL BASIS OF MUSIC

FAITHFUL LOUDSPEAKER REPRODUCTION

A search for quality is the dominant aspect of receiving set design to-day and, since to attain this desirable end some knowledge of the science of acoustics is an essential, we present some facts worthy of study by the radio listener.

TO fix our ideas we may imagine the simple experiment of a piece of clock spring clamped in a vise so that a long length projects from the jaws. On drawing the free end of the spring to one side and releasing, it will be found that the spring vibrates backwards and forwards fairly slowly. If the vibrating length of the spring is gradually shortened it will be found each time that the vibration becomes more rapid until a stage is reached where it is difficult to see the actual movement of the spring. But where sight fails us hearing comes to our aid and a more or less musical sound is heard. In shortening the spring still further it will be found that the emitted note rises in pitch.

THE NATURE OF SOUND

When our spring moves to the right it pushes in front of it and compresses together some of the air particles in its path, but to the left of the spring the movement tends to create a vacuum and leaves the air in a somewhat rarefied condition. As the spring moves over to the left the action on the air particles is similar except that the air is now compressed on the left and rarefied on the right of the spring. The result is that as the spring vibrates backwards and forwards a series of waves of compression and rarefaction travel outwards from it.

A similar result is got by the movement of the diaphragms of telephone receivers or the cone of a loud speaker when broadcasts are being received and the compressions and rarefactions arriving at the ear push the ear drum backwards and forwards. This causes a series of three articulated bones to move creating pressures on nerves within the ear and those pressures are interpreted by the brain as a sound similar to that of the original.

LOUD SPEAKER PLACEMENT

It is not always that the ear will hear a clear sound when the loud speaker is in operation. It is possible that there may arrive at the ear an air compression direct from the loud speaker at the same time as a rarefaction received indirectly from the back of the cone or reflected from the walls or from other sources. In such a case the tendency is for the compression to cancel out the rarefaction with the result that the sound is appreciably weakened. On the other hand, should direct and indirect compressions arrive at the ear simultaneously, they will reinforce one another and the resultant sound will be considerably louder than it should be. It follows that in testing a loud speaker the listener should move to various places in the room to listen and should try putting the loud speaker in various positions until one is found where interference between waves is unnoticeable.

The necessity for a baffle board to prevent the interaction between the compressional and rarefactional waves from the back and front of a cone speaker should now be obvious.

THE MEANING OF FREQUENCY AND PITCH

Reverting to our simple clock spring experiment, it will be recalled that the shorter the length of spring the more rapid the vibrations and the higher the pitch of the note produced. Now any sounding body emitting a musical note vibrates regularly, i.e., it takes always the same time for the vibrating body to move, say, from the extreme left position over to the right and back to the left provided that the pitch of the note is not changing. The size or amplitude of the vibration has no effect on the time of vibration, but it affects, of course, the loudness of the sound emitted.

Movement from the extreme left, over to the right and back to the original position constitutes one **cycle.** The number of cycles per second is known as the **frequency** and it should be apparent that it is the frequency of vibration and nothing else which determines the pitch of a note. The frequency, and therefore the pitch, can be altered in a number of ways, e.g., in stringed instruments by having long and heavy strings for low notes and short and light strings for high notes. To give an idea of frequency it may be mentioned that the lowest note on the piano has a frequency of about 27 cycles, the highest note about 4,000 cycles and middle C about 268 cycles on the ordinary standard of pitch. There is given in Fig. 1 some idea of frequency range, the piano in this case being tuned to the scientific standard of pitch with middle C 256 cycles.

CHANGES OF PITCH.

The ear is very sensitive to change of pitch, but, it may be noted, very insensitive to changes in loudness of

Frequency Ranges of Musical Instruments

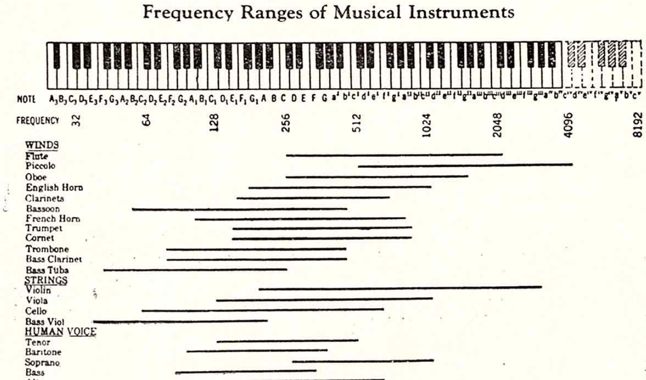


Figure 1.

music unless the sound is very weak. Notes of very low and very high pitch are not interpreted as sound, but their presence is rather "felt." The limits of satisfactory audibility probably lie between 20 and 8,000 cycles, but the range of frequency for notes having any real musical value lies between 40 and 4,000, and any receiving set which will amplify frequencies uniformly over this range will meet most requirements.

WHY INSTRUMENTS DIFFER

In connection with musical notes we have so far mentioned the factors loudness and pitch yet if notes of the same pitch and loudness are played on different instruments they do not sound the same. The third factor involved is known as **quality,** and for a full investigation of musical values the reason for differences in quality must be discussed.

Let us suppose a note of frequency 200 is played on an instrument. The note played is called the **fundamental** and in general is accompanied by a number of tones of frequency other than the fundamental. These additional notes are called generally **overtones** and if their frequency is a whole number of times that of the fundamental they are called **harmonics.** Only a very few instruments, for example, bells, produce notes of frequency not an integral multiple of the fundamental and therefore not harmonics. The customary notation is to call the fundamental note —the note actually struck—the first harmonic ; the note of frequency twice that of the fundamental, the second harmonic ; the note of three times the fundamental frequency the third harmonic, and so on.

Now different instruments produce different harmonics and in addition produce them at different relative loudness or intensity. These two factors determine the quality of a musical note.

Instrument	Harmonics and their relative intensities							
	1	2	3	4	5	6	7	8
Piano	100	99.7	8.9	2.3	1.2	.01	—	—
Harp	100	81.2	56.1	31.6	13	2.8	—	—
Violin	100	25	11	6	4	3	2	1.5

Figure 2

THE HARMONICS OF SOME INSTRUMENTS

Generally the second harmonic is of much less intensity—loudness—than the first harmonic—the fundamental ; in the case of the piano, nowever, the second harmonic is as loud as the fundamental and it is shown in Fig. 1 as having a frequency 8192 cycles when the fundamental is 4096.

To get an idea of the relative strengths of some harmonics the table of Fig. 2, with the fundamental having a loudness 100, may be consulted.

The violin has harmonics extending beyond the 8th. The human voice goes still further and has harmonics extending up to the 16th and these long series account for the richness of tone of the violin and the voice. Good singers can produce the harmonics with their proper strengths.

The flute has only one overtone, the 2nd harmonic of only weak strength, and this accounts for its comparative flatness of tone. A tuning fork produces a pure tone giving the fundamental only.

WHAT IT ALL MEANS

The point about harmonics in radio reception is that if the reproduction is to be natural the receiving set must be capable of responding to all the harmonics present in the original sound and emitting them from the loud speaker at their proper relative strength. It is easy to see therefore that the set must handle a fairly wide range of frequencies and must, at the same time, not introduce harmonics not present in the original sound as an incorrectly operated power valve will do.

A set covering a frequency range of only 500 to say, 2,500 cycles will reproduce speech which can be easily understood, but lacking from the point of view of naturalness. Good intelligibility and natural reproduction need a frequency range of about 100 to 3,000 cycles, while if we extend this frequency range up to 4,000 or 5,000 cycles the naturalness increases because we have more harmonics.

Frequencies below 300 or so tend to give "body" to the sound. So if our reproduced music is to be anything like the real thing we must have a good proportion of bass On the other hand, if we have too much bass we shall tend to lose intelligibility, as is shown if we have a boomy loud speaker, when it becomes difficult to understand what the announcer is saying.

A study of the facts we have given in this article will give the reader an appreciation of the difficulties encountered by the designer of receiving sets and how well the problem is being tackled by many manufacturers.

A NOVEL EARTH

A WRITER who recently has been carrying out tests with several different kinds of earths, states that one that gave conspicuous good results was as follows :—

It consisted simply of a coil made from 6ft. or so of copper gas tubing, such as is used for "remote control" of bypasses. This may be obtained from almost any ironmonger or gas supply company, and is about ¼in. in thickness.

Petrol piping from a car is equally good, though rather more expensive to buy.

The tubing is formed into a coil of about 6in. diameter, and buried with one end just protruding above ground. To this end the earth lead is soldered.

The edges of the tube at this end are hammered out into a small funnel, into which water may be poured from time to time.

A.C. APPARATUS

Small Mains Transformers

The most important component of an A.C. battery eliminator or power-pack is the transformer and many home constructors are ambitious enough to undertake its manufacture. Let it be stressed, however, that the construction of this piece of apparatus should be attempted only by the amateur who has a capacity for taking pains and paying attention to detail, otherwise serious failure may result. Any electrical apparatus to be connected to the supply mains needs to be built with extreme care if all element of danger by shock or fire is to be avoided. The construction of a power transformer should therefore not be undertaken as lightly as the building of a battery-operated set. Wherever possible we recommend the purchase of transformers from a reputable manufacturer.

It is an easy matter for the amateur to obtain tables giving figures showing the number of turns of wire, etc. Such rough and ready methods may not always prove satisfactory. For example, the filaments of indirectly heated valves are rated to take a certain current which is generally critical in that overloads result in a material shortening of the life of a valve. It should be obvious, then, that satisfactory building transformers is to be had only by access to the A.C. meters necessary for measuring voltage outputs at rated loads so that the finished transformer may be thoroughly tested before it is used in the set.

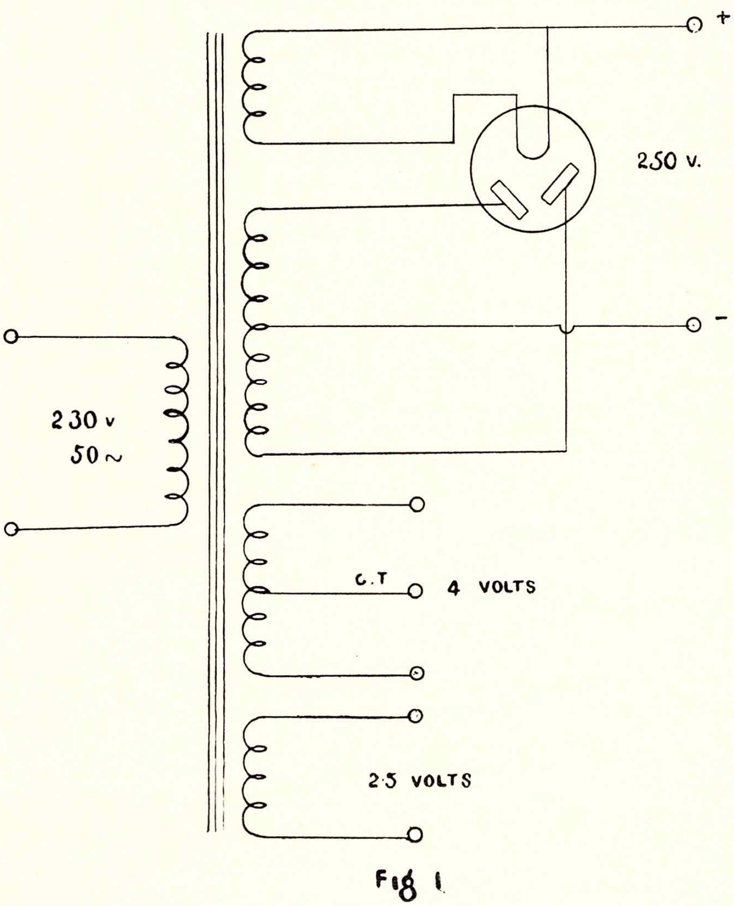


Fig. 1. Schematic Diagram of Power-Pack Transformer.

THE ESSENTIALS OF A TRANSFORMER

The basic principles of the action of a transformer may be summarised briefly as follows. An insulated winding of wire known as the primary, is put over a core of special iron known as Stalloy. Wound on the same core, usually over the primary, are placed one or more secondary windings. The secondaries are insulated from one another and from the primary.

The number of turns of wire in the primary is determined by the mains voltage, the frequency of the supply, and the size of the iron core. When the transformer is in use the primary winding is connected to the mains and a current will flow in it when a load is placed on the secondaries. The alternating current in the primary causes changes in the magnetic state of the iron and this in turn induces voltages at the ends of the secondary windings. The magnitude of each induced voltage will depend upon the proportion of the number of turns in the secondary to the number in the primary. For example, if the number of turns in the secondary is one-tenth the number in the primary the induced voltage in the secondary will be one-tenth that of the mains voltage. Of course there is, in the design of a transformer, other factors than the ratio of the number of turns to be considered.

SOME SIMPLE ELECTRICAL LAWS

In order to show constructors how to design a transformer for particular needs, it is our intention to take a special transformer, one to be used with a valve rectifier as repesenting the most complicated type, and work out all the particulars for it, concluding with an account of the method of construction.

Any constructor who follows out the simple arithmetical calculations will have no difficulty in designing a transformer for his particular needs. Two important electrical laws form the basis of most of the calculations.

The first of these is the fundamental fact known as Ohm's Law. For our purpose this may be stated as follows:— "The voltage between the ends of a conductor

divided by the current in it is equal to the resistance of the conductor.'' The law may be expressed in other ways such as

$$\frac{\text{volts}}{\text{amperes}} = \text{ohms}$$

or

$$\text{volts} = \text{amperes} \times \text{ohms}$$

or

$$\text{amperes} = \frac{\text{volts}}{\text{ohms}}$$

The second electrical fact that concerns us here is the calculation of the power used in electrical circuits. The power is measured in watts and the watts used is equal to the product of the voltage at the ends of the circuit and the current in it, i.e.

$$\text{Watts} = \text{volts} \times \text{amperes}$$

or

$$\text{amperes} = \frac{\text{Watts}}{\text{volts}}$$

THE POWER OF THE TRANSFORMER

The A.C. electrical supplies seem to be standardised in New Zealand at 230 volts, 50 cycles and our calculations will be for transformers to work off such mains.

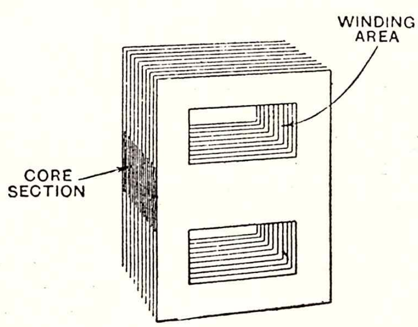


Fig. 2. Shell-type laminations.

The first step in design is to decide what outputs are required. In this connection the constructor should try to anticipate his wants a few years hence and should build generously for fairly high power output, even although his immediate need is only for a power pack for a simple receiving set.

Our transformer is for a valve rectifier and where copper oxide rectification is to be used the winding for heating the filament of the rectifier will not be necessary. With the oxide rectifier it will be necessary to consult the manufacturer's figures for the output to be handled by the particular type selected.

Let us take a transformer to deliver outputs as follows :—

(1) 250 volts at 60 milliamperes, i.e., .06 amps.

(2) 5 volts at 2 amps., to heat rectifier valve.

(3) 4 volts at 4 amps. for filaments of English valves.

(4) 2.5 volts at 1.5 amps. for power valve.

On full load the power taken by each winding will be :—

(1) 250 x .06 = 15 watts.
(2) 5 x 2 = 10 watts.
(3) 4 x 4 = 16 watts.
(4) 2.5 x 1.5 = 4 watts.

Total power taken by secondaries = 45 watts.

The power used in the primary will be greater than this by an amount depending upon the efficiency of the transformer. In a small transformer of the type used in power-packs it should not be difficult to realise an efficiency of 75 per cent.

Therefore on full load we have

$$\text{Power in primary} = 45 \times \frac{100}{75} = 60 \text{ watts.}$$

The windings for this transformer are shown diagrammatically in Fig. 1. It will be noticed that the 4-volt winding is centre-tapped. A centre-tap on the rectifier filament winding is not necessary although it is frequently made.

THE TRANSFORMER CORE.

The windings have to be made over a core of Stalloy iron. The core is made up of laminations and the dimensions of the assembled iron are of some importance. Two types of core are in general use and are shown in Figures 2 and 8. With the former the windings are made on the central cross-piece while in the latter, the windings are put on one of the long legs.

The dimensions of the winding leg may not be chosen haphazardly as the iron used must have a definite area depending upon the power of the finished transformer. For our transformer it would be suitable to have the width of the winding leg 1 inch and to build up the laminations to a thickness of 1.5 inches as shown in Figure 3. Suitable core sections for transformers of different power inputs are shown in Table A.

TABLE A.

Input Watts	Area of core Cross-section	Possible core dimensions Width	Thickness
25	1.1 sq. ins.	¾in.	1¼in.
		1in.	1in.
50	1.5 sq. ins.	1¼in.	1¼in.
		1in.	1½in.
75	1.9 sq. ins.	1in.	2in.
		1¼in.	1½in.
100	2.2 sq. ins.	1½in.	1½in.
		1¼in.	2¼in.
200	3.0 sq. ins.	1¾in.	1¾in.
		1½in.	2in.

The transformer to be described here has a power input of 60 watts and the core will therefore have an area of 1.5 square inches.

THE TURNS PER VOLT

There must be determined next the number of turns to be put on for each winding, Since the voltages obtained

are in proportion of the number of turns in each winding it is customary to work out the "turns per volt" as this, when multiplied by the required voltage, gives the total number of turns for each winding.

An approximate formula for the calculation is that

$$\text{Turns per volt} = \frac{500}{\text{supply frequency x area of core section}}$$

It has been decided that a core of cross-sectional area 1.5 quare inches will be used and it should be

TABLE B. COPPER WIRE

S.W.G.	Diameter in inches	Turns per in. D.C.C.	Turns per in. Enamel	Lbs. per 1000 yds. D.C.C.	Lbs. per 1000 yds. Enamel	Safe Current in Amps	Ohms per 1000 yds
16	.064	13	15	39	37.2	3.8	7.46
18	.048	17	20	22.2	20.9	2.2	13.27
20	.036	22	26	12.6	11.8	1.2	23.6
22	.028	25	33	8.1	7.1	.74	39 0
24	.022	30	42	5.16	4.39	.46	63.2
26	.018	36	50	3.39	2.94	.31	94.4
28	.0148	39	61	2.36	1.99	.20	139.6
30	.0124	44	72	1.71	1.40	.145	199.8
32	.0108	50	83	1.24	1.06	.11	261.1
34	.0092	54	98	1.09	.77	.08	361.2
36	.0076	63	122	.79	.52	.055	529.3
38	.0060		143		.33	.034	849.1

noticed that air spaces and insulation occupy some of this, area so that the amount of actual iron will be about only 9-10ths of 1.5, or 1.35 square inches.

For a 50-cycle supply the approximate formula becomes

$$\text{Turns per volt} = \frac{10}{\text{area of core}} = \frac{10}{1.35} = 7.4$$

The calculation is very simple, but may be avoided by reference to Figure 4 where the corresponding areas of core section and turns per volt may be read off. The chart is for a 50-cycle supply and stalloy iron only.

THE PRIMARY WINDING

Using the figure 7 turns per volt the primary winding will have 230 x 7 = 1610 turns. The wire will have to carry the primary current without overheating. Now by formula

$$\text{Current} = \frac{\text{watts}}{\text{volts}} = \frac{60}{230} = .26 \text{ amperes.}$$

From Table B it will be seen that No. 26 wire must be used.

The thickness of the insulating coverings to be added to the wire diameter to give the overall dimensions are as in Table C

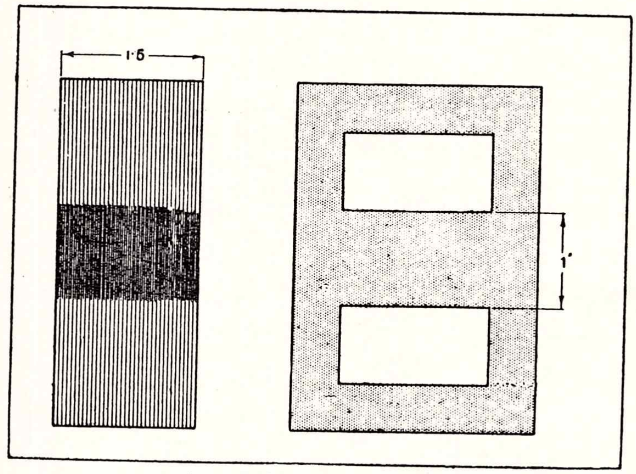


Fig. 3. Transformer section.

Enamel wire is almost invariably used in small transformers because of the economy in space effected, but D.C.C. wire may be used for the filament windings which require comparatively few turns.

THE PRIMARY WINDING

It has been decided that the primary winding will consist of 1610 turns of No. 26 S.W.G. enamelled wire

TABLE C.

S.W.G.	Thickness to be added in inches D.C.C.	Thickness to be added in inches Enamel
16	.012	.0025
18	.010	.0025
20	.010	.0022
22	.010	.002
24	.010	.0017
26	.010	.0017
28	.010	.0015
30	.010	.0012
32	.009	.0012
34	.009	.001
36	.008	.001
38	.008	.001

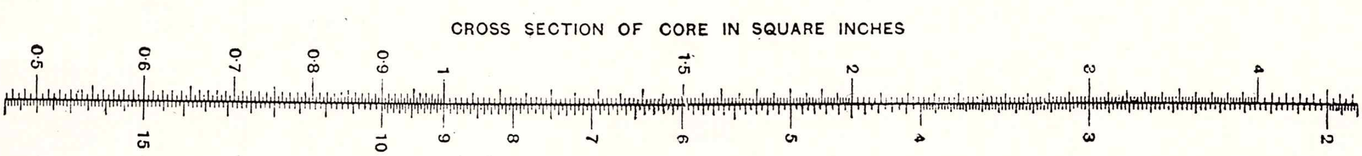


Fig. 4

and we may now proceed to calculate the space it will occupy. Let us suppose that the length available for the actual winding on the core is 2-5/8 inch. Reference to Table B shows that in this space there may be put 162 turns of No. 26 enamelled wire, and to accommodate 1610 turns ten layers will be required. Now the diameter of No. 26 enamelled wire, is allowing for the covering, .018 + .0017 = .0197 inch. Therefore ten layers will occupy a depth of ten times this or approximately .2 inches. But each layer is separated from the succeeding layer by thin paper and we must allow at least 25 per cent. for paper and uneven winding. Unless the constructor had facilities for accurate winding it would be advisable to add 50 per cent. for unevenness. Taking the figure as 25 per cent. the winding would occupy .25 or ¼-inch.

QUANTITY OF WIRE REQUIRED

In Fig. 5 is shown a section of the core 1½ x 1 inch. A winding of depth ¼ inch increases the dimensions to 1¾ x 1¼ inches and the average winding length on the longer arm is 1 5-8 inch and on the shorter arm 1 1-8 inch. Hence the average length of each turn of wire is 2 x 2¾ = 5½ inches.

Therefore total length of 1610 turns

$$= \frac{1610 \times 5\frac{1}{2}}{36} = 246 \text{ yards}$$

Now Table B shows that for No. 26 enamel there are 1000 yards in the 2.94 lb. Hence the total weight of wire required will be

$$\frac{246}{1000} \times 2.94 = .72\text{lb.} = \frac{3}{4}\text{lb. approximately}$$

VOLTAGE DROP IN THE PRIMARY

Further reference to Table B shows that the resistance of 246 yards of No. 26 wire = 246 x .094 = 23 ohms approximately, and this winding on full load takes a current of .26 amps.

Now voltage drop = amps. x ohms
= .26 x 23
= 6 volts approximately

Therefore on full load the voltage at the ends of the primary winding will be 224 and not 230. If the secondary windings are to give their rated voltage this voltage drop in the primary will have to be taken into account in reckoning the number of turns.

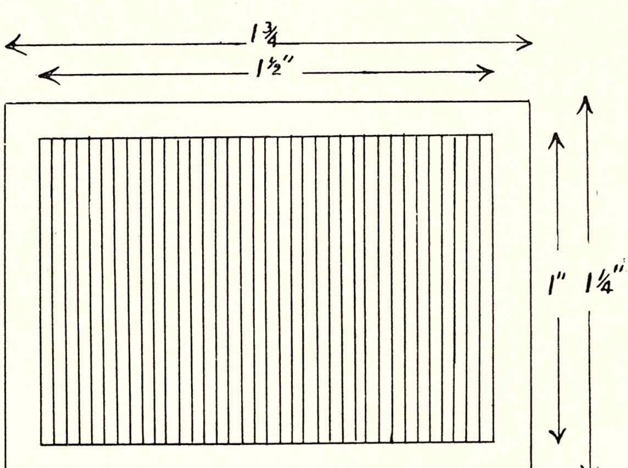


Fig. 5. The average winding depth.

THE HIGH TENSION SECONDARY

This winding is to deliver 250 volts at .06 amp. at 7 turns per volt the number of turns will be 7 x 250 = 1750, but as full-wave rectification is required it will be necessary to put this number of turns on each side of the centre tap. The winding may therefore consist of 3500 turns with a centre tap, and to carry the current Table B shows that No. 34 enamelled wire will be used.

In a winding length of 2-5/8 inch there can be put 257 turns and for 3500 turns fourteen layers will be necessary. Working as for the primary it can be shown that the winding depth will be 1/6 inch and the average length per turns about 6 inches.

$$\text{Hence length of winding} = \frac{6 \times 3500}{36}$$
$$= 580 \text{ yards approx.}$$

Therefore weight of wire required =

$$\frac{580}{1000} \times .77 = .45\text{lb.} = 7 \text{ ozs. approximately.}$$

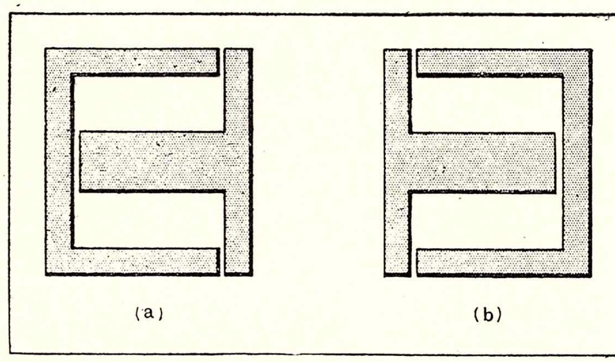


Fig. 6. Method of assembly of shell-type laminations.

THE VOLTAGE DROP IN THE H.T. WINDING

Since 580 yards of No. 34 wire have a resistance of 580 x .36 = 210 ohms approximately the voltage drop in this winding will be = 210 x .06 = 12.6 volts.

But there is already a voltage drop in the secondary due to the voltage drop in the primary and it is equal

$$\text{to } 6 \times \frac{250}{230} = 6.6 \text{ volts approximately}$$

Hence the total voltage drop is 12.6 + 6.6 = 19.2 volts

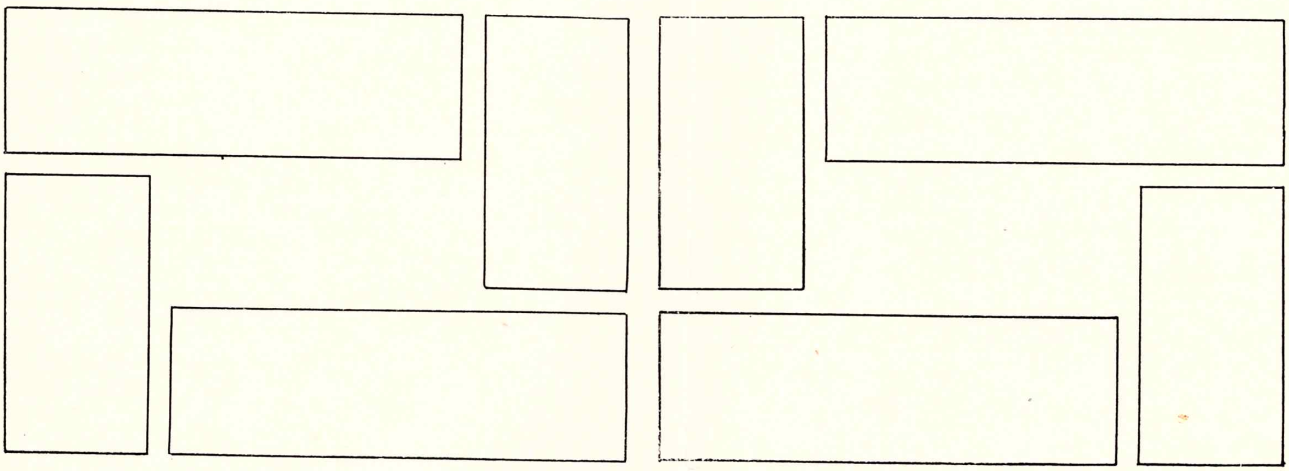
$$\text{i.e. } \frac{19.2}{250} \times 100 = 8 \text{ per cent. approximately}$$

Therefore to obtain our 250 volts at 60 milliamps. we shall require not 1750 on each side of the centre tap, but this number increased by 8 per cent. i.e., 1890 turns, or 3780 turns for the whole winding.

RECTIFIER FILAMENT WINDING

This winding has to carry 2 amperes and therefore No. 18 gauge will be necessary. D.C.C. wire may be used if obtainable more easily than enamelled wire.

At 7 turns per volt, 35 turns would be required, but a calculation similar to that above shows a 6 per cent. voltage drop to be allowed for and therefore 37 turns are required.



(a) (b)

Fig. 7. Showing method of assembling alternate layers of the core.

VALVE FILAMENT WINDING

Twenty-eight turns of No. 16 D.C.C. wire are nominally required, but allowing for voltage drop, 30 turns should be put on and tapped at the centre point i.e., at the 15th turn.

Allowing again for voltage drop, 18 turns of No. 18 D.C.C. wire will be required for the power valve winding delivering 1.5 amps at 2.5 volts.

All the filament windings will go in one layer in a winding length of 2-5/8 inch. The total winding depth for all windings will be about 11-16th inch.

THE REASON FOR THE CALCULATIONS

We have discussed at some length the calculations involved in transformer design, even though an endeavour has been made to summarise construction details in table form. Constructors will desire transformers for all sorts of purpose and greatest satisfaction will result from designing the particular transformer from first principles so that a study of the method followed should be well worth while. Further, stalloy stampings are available in a number of different sizes and the amateur may have to adapt his design to the particular type he can buy. His difficulties will be avoided if the retailer of the stampings can give sound advice on size of core, turns per volt, etc. Calculations of winding depth are of no little importance since, in an efficient transformer, the winding will be arranged to fill the whole winding area; or looked at in another way, the size of the winding area will be chosen such as to take all the winding with practically no space to spare.

SUMMARISED INSTRUCTIONS

Before commencing on the practical details of transformer construction, we give in Table D condensed information on core sizes and practical turns for different windings.

The cross-sectional area of the core in Table D is for the actual area of iron, and to get overall dimensions of the assembled stampings the areas in the table should be multiplied by 10-9ths.

BUILDING THE TRANSFORMER

The stalloy laminations of most suitable dimensions will be purchased and should be put together in order to ascertain fairly exactly the size of the leg on which the windings are to be placed. One side of each lamina will be found to be insulated by a thin layer of paper or paint and, in assembling, it will be necessary to place an uninsulated side in contact with and insulated side.

TABLE D.

Transformer Details for Stalloy Cores on Supplies at 230 volts - 50 cycles

Power Input (Watts)	Core Section in Sq. inches	Turns per Volt	Total Primary Turns	Size of Primary Wire S.W.G	Practical Secondary Turns								
					1.5 volts	2.5 volts	4 volts	5 volts	150 volts	200 volts	250 volts	300 volts	400 volts
25	1.1	8.6	1980	32	14	24	38	48	1420	1890	2660	2840	3780
50	1.5	6.0	1380	28	10	17	27	33	990	1320	1650	1980	2640
75	1.9	4.8	1100	26	8	14	21	27	790	1060	1320	1580	2110
100	2.2	4.1	940	24	7	12	18	23	680	900	1130	1350	1800
200	3.0	3.0	690	20	5	9	13	17	500	660	830	990	1320

The types of stalloy laminations which may be obtained are two. The first of these is shown in Fig. 6 and the second in Fig. 7. The diagrams also show the method of assembling alternating layers so as to avoid air gaps in the magnetic circuit. Fig. 8 shows the assembled core with the windings in place. The laminations in the core type of Figures 7 and 8 should all be of the same width, whereas the type of Fig. 6 usually has the central strips on which the windings are to be made wider than the others. In making calculations it is the dimensions of the central portion which are taken into consideration.

THE METHOD OF WINDING

The method of winding must next be considered. One system is to place the windings in two separate bobbins which slip on the core and to place one half of each winding on each bobbin, the ends being joined on completion of the transformer. Bobbins for such transformers are shown in Fig. 9 and a finished transformer in Fig. 10.

A simpler method is that shown in Fig. 8 and in the photograph, Fig. 11 of a finished transformer using shell-type laminations.

Having assembled the core and determined its dimensions, a cardboard spool of the shape shown in Fig. 9 should be made and glued together. The tunnel through the centre should fit tightly over the core. The inside of the bobbin may be covered with a layer of tape, oiled silk, "empire cloth" or similar material to prevent possible damage to the first turns of wire by sharp cardboard edges.

To obtain even winding of the layers some sort of mechanical winding device is necessary such as a lathe with a back gear attachement. Failing this a simple coil winding machine may be built as in Fig. 12. A revolution counter attached to the shaft will be a desirable accessory.

Several strips of thin paper must be prepared of sufficient length to pass round the bobbin and of width a little greater than the distance across the inside of the bobbin. These will serve to separate the layers and assist in even winding. The width of the paper will allow the strip to curl up slightly at the edges and assist in good separation.

THE PRIMARY WINDING

For the ends of each winding, holes must be made in the side of the bobbin, care being taken to make them in the shorter sides of the rectangular former otherwise the leads may be obscured by the iron of the assembled transformer. Connections to the beginning and end of the winding should be made by soldering No. 24 wire and slipping a piece of paper round the soldered joint. This is essential with the the fine wire of the H.T. secondary.

The primary winding is started by a full layer with turns touching and a strip of the paper put over the first layer. The second layer is wound over the first, and so on until the full number of primary turns are wound on, remembering to put a paper strip between each layer. Sufficient tension should be put on the wire to ensure a tight winding.

THE SECONDARY WINDINGS

To obtain proper insulation three layers of oiled silk or empire cloth a fraction of an inch wider than the inside of the former are put over the primary winding.

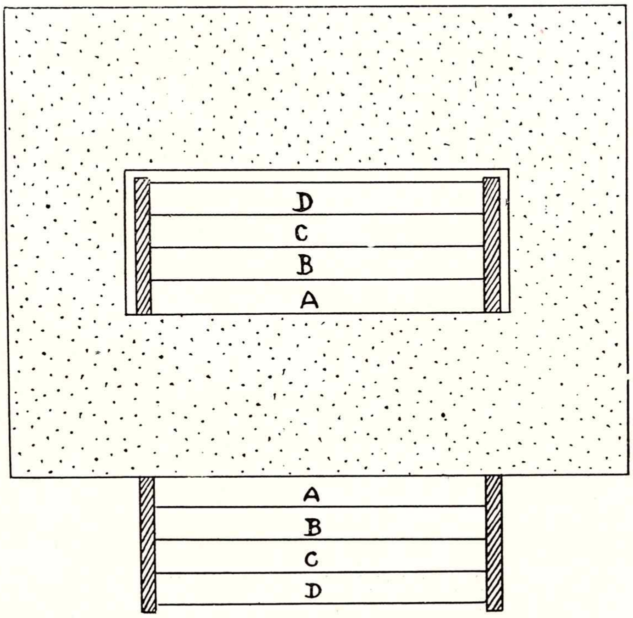


Fig. 8. Assembled core showing windings.

The next step is to put on the H.T. secondary winding using the same general method as before. With the finer wire now being used too great a tension must not be applied, and at the same time greater difficulty in getting an even winding will be experienced. Wind as evenly as possible and with care and the assistance of the paper between layers a satisfactory winding will result.

This secondary winding has to be tapped and it will be desirable to arrange for the tapping point to coincide with the end of a layer. A soldered connection of No. 24

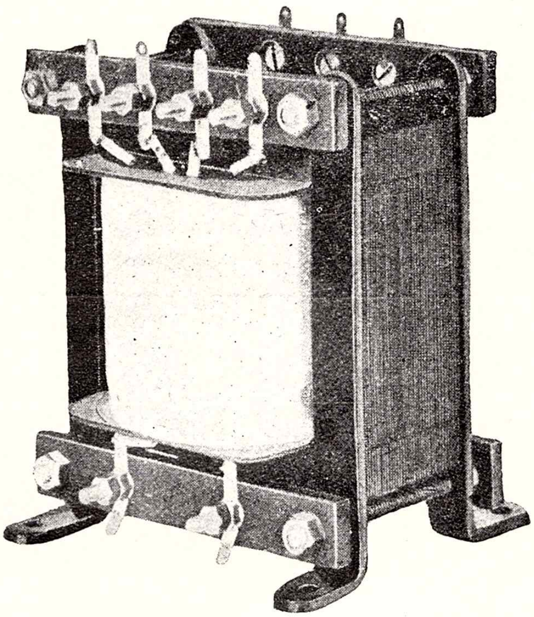


Fig. 9. Bobbins for sectionalised windings.

wire should be made at the tapping inside the former and the thicker wire taken through the bobbin. To prevent the possibility of breaking at the soldered connection to the beginning and end of this winding, it will be advisable to commence and finish the winding with a few turns of the thicker wire.

The next winding to be put on is that for heating the filament of the rectifier valve. As a considerable difference in voltage exists between this winding and the HT.. secondary the two windings must be carefully

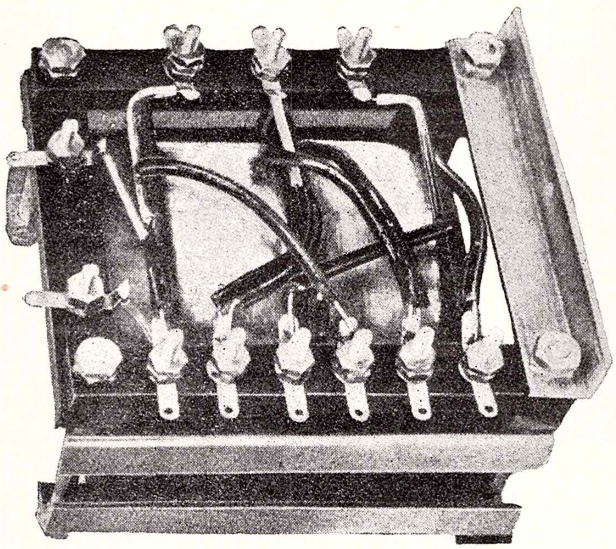


Fig. 10. This view of the finished transformer shows clearly the manner in which the terminal battens are attached to the holding-down bolts.

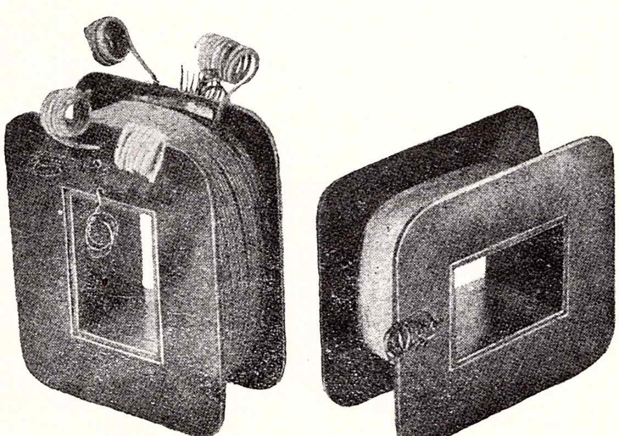


Fig. 11. The two bobbins; one finished, the other only partly wound. Note the method of finishing off the thick wire coils.

insulated. The No. 18 D.C.C. wire is fed through a hole in the cheek of the former and the winding put on. This winding is insulated and followed by any valve filament windings with their centre tap where thought desirable. Each winding is insulated from the one preceding it.

The last winding may be given a thin coat of shellac and finally covered with insulating cloth or taped to provide a pleasing finish.

ASSEMBLING THE TRANSFORMER

The transformer stampings must now be reassembled, this time through the tunnel until the opening is filled with iron. If the bobbin is loose on the core it must be firmly wedged with thin strips of wood. Remember to reverse the order in each layer of the stampings and keep the insulated sides of the stampings the same way up throughout.

The iron must now be clamped rigidly otherwise a hum will be heard when the transformer is in operation. To hold the iron, pieces of ½ inch angle brass may be used. Holes to pass screwed rod must be drilled in the clamping strip in such positions that the rods do not touch the laminations, otherwise all the advantage of using insulated stampings will be lost. Terminal strips cut from ebonite or formica can be clamped on to the extension of the holding bolts and small terminals, or screws and nuts, used to finish off the transformer as shown in Fig. 11.

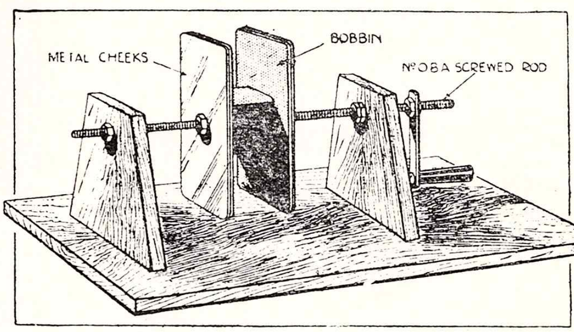


Fig. 12 Lay-out of the coil winder mentioned in the text. Metal end plates are required to hold the bobbin and prevent bulging.

SOME PRACTICAL POINTERS

(1) Use only stalloy iron for the core, assemble it carefully according to the instructions above, and pay especial attention to making a rigid final assembly.

(2) Before winding, sketch the transformer to scale. It is bad design not to fill practically all the winding area and at the same time it is rather disastrous to find sufficient room to accomodate all the windings has not been allowed for.

(3) Use enamel wire of only the highest grade and watch the wire carefully as it goes on for faulty insulation. Slip a piece of paper round any faulty portion. A short-circuited turn will ruin the transformer.

(4) At the completion of each winding make a test for continuity with head-phones and battery.

(5) Wedge the winding spool tightly on the core.

(6) On completion of the transformer connect the primary to the mains with no load on the secondaries. The disc of the electric supply meter should show no sign of movement. Current consumed by the primary on no secondary load will indicate short circuited windings.

(7) Tests of voltage outputs under load should be made if the use of the necessary A.C. and D.C. meters can be obtained.

Audio-Frequency Chokes

CONSTRUCTIONAL DETAILS OF A USEFUL COMPONENT

WHERE the mains are used as the source of power for a wireless set it is essential for quiet operation to smooth out the ripple in the D.C. mains or the rectified plate supply from A.C. mains. This is accomplished by the use of a filter consisting of a combination of condensers and one or more audio-frequency choke coils. The latter can be made readily by the amateur constructor.

The choke consists of a coil of wire wound, as with a transformer, over a core of Stalloy iron laminations, the laminations being covered with thin paper, shellac or rust if losses are to be avoided. There is, however, a very important difference in the method of assembling the core from that adopted with a transformer. It will be recalled that in our description of the assembly of the

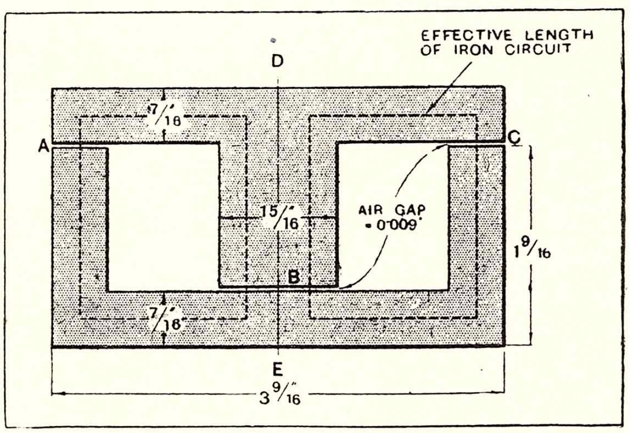


Fig. 1. Showing the essential dimensions.

transformer coil it was stressed that the laminations be placed in such a way that no air gaps occurred in the magnetic iron circuit. With a choke, which should offer a nearly constant inductance independent of the size of the current through it, an air gap must be introduced. This air gap, as well as preventing saturation of the core, offers a means for adjustment of the inductance of the choke. The actual size of the gap to be used in any particular case is calculated with difficulty.

A USEFUL CHOKE

A choke coil having an inductance of 20 henries and capable of carrying a current of 100 milliamperes will be found suitable for most requirements in receiving set construction. Such a choke may be wound on British core stampings of the size shown in Fig. 1. One hundred pairs of these stampings will be required and they should be assembled one on top of the other with air gaps as shown. The thickness of the air gap should be .009 inch or the thickness of a piece of No. 34 S.W.G. wire. Distance pieces must be inserted at A, B and C of the right thickness; they may consist of shellaced cardboard.

A bobbin should now be made to fit into the winding space of the core as shown in the photograph of the finished choke. The bobbin should be wound with 4,000 turns of No. 32 S.W.G. enamel wire, the turns to be run on evenly, but not necessarily in layer form with consecutive turns touching. Sufficient care in winding to avoid waste space is necessary, however.

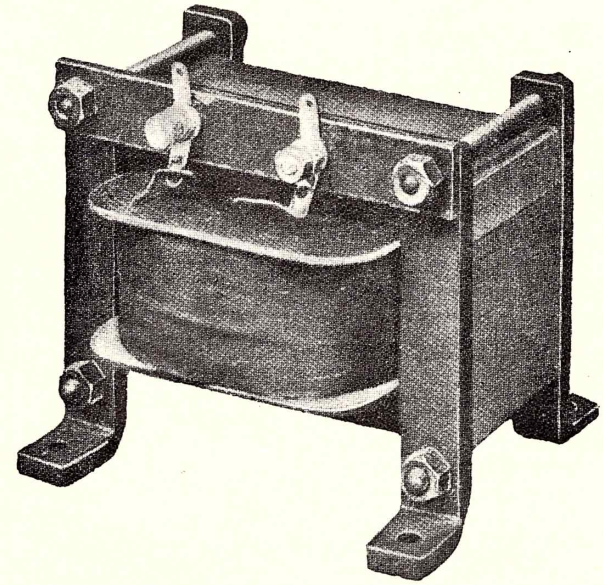
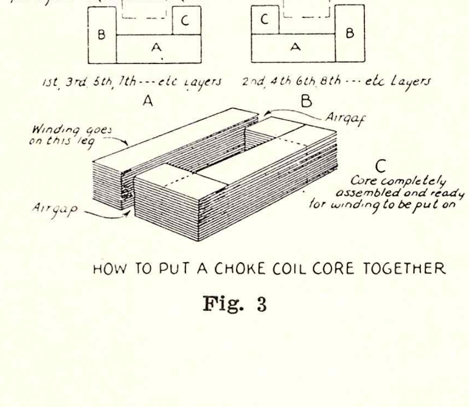


Fig. 2. The robust and compact construction of the choke will be apparent from the photograph.

With the winding on, the "T" pieces of the core are inserted into the bobbin, as many as possible being packed in, and the final two or three tapped home if necessary. Any looseness in the core when finally clamped will lead to a hum when the choke is being used as a smoothing choke, or to its acting as a miniature loud speaker when employed as an output choke.

The spacing pieces can then be placed in position, and the "U" shaped laminations assembled, using the same number of these as there are "T" pieces. During the assembly of the stampings all paper-covered sides must point in the same direction. If a little adhesive is smeared on both faces of the air gap spacers, it will assist in keeping them in position.

The steel clamps are fixed in position as shown in the photograph with an insulating terminal strip on the top. Before the clamps are placed in position a strip of insulating material, such as shellaced paper, or empire cloth, should be inserted between each clamp and the



HOW TO PUT A CHOKE COIL CORE TOGETHER

Fig. 3

core to prevent partial short-circuit of the air-gap. The D.C. resistance of the coil will be about 220 ohms.

ALTERNATIVE DESIGN

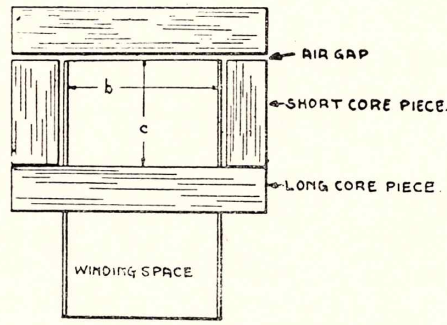
It may not be possible to obtain everywhere the type of stampings referred to above so an alternative design is shown in Fig. 3 which also gives the method of assembling the laminations.

In this case the winding is put on the long leg at the top over a layer or two or insulating tape wound round the assembled laminations. It will be noticed that laminations of the "U" piece are put so that no air gaps occur in it.

In Fig. 4 is shown a case where the winding is put over the long limb of the U. The dimensions marked "b" and "c" occur in the table below.

In this type the winding and mounting of the finished choke by means of clamping pieces are carried out in the same general manner as described for the earlier choke.

The table below gives dimensions for chokes of different sizes together with the corresponding approximate air gap.



ARRANGEMENT OF INDUCTANCE COILS.

Design Data for Iron-Cored Chokes

Core Size	Inductance	Air Gap		Wire Enammelled	No. Turns	Winding Form		Core Dimensions	
Cross Section	Henrys	Decimals	Nearest Fraction	S.W.G.		b	c	Long Piece	Short Piece
½" x ½"	10	.030"	1/32"	No. 36	7600	0.90"	0.[illegible]"	½ x 2.1"	½ x .85"
¾" x ¾"	10	.030"	1/32"	No. 36	5000	0.73"	0.49"	¾ x 2.5"	¾ x .75"
	20	.044"	3/64"	No. 36	7600	0.91"	0.60"	¾ x 2.7"	¾ x .85"
1" x 1"	10	.030"	1/32"	No. 36	3800	0.64"	0.43"	1 x 3.0"	1 x .75"
	20	.044"	3/64"	No. 36	5700	0.78"	0.52"	1 x 3.1"	1 x .75"
	50	.100"	7/64"	No. 36	11000	1.10"	0.75"	1 x 3.5"	1 x 1 0"

ALL THE ABOVE CHOKES WILL CARRY 50 MILLIAMPS

THE CHOKES BELOW WILL CARRY 100 MILLIAMPS

¾" x ¾"	10	.030"	1/32"	No. 32	5000	1.00"	0.67	¾ x 2.6"	¾ x .95"
1" x 1"	10	.030"	1/32"	No. 32	3800	0.86"	0.58"	1 x 3.0"	1 x .85"
2" x 2"	10	.030"	1/32"	No. 32	1900	0.60"	0.42"	2 x 4.66"	2 x .60"
	20	.044"	3/64"	No. 32	2900	0.75"	0.51"	2 x 4.85"	2 x .75"
	50	.100"	7/64"	No. 32	5300	1.00"	0.70"	2 x 5.50"	2 x .95"

CONNECTING TERMINAL TAGS

ALMOST endless ways of connecting terminal tags to various types of leads have been described from time to time. A one-inch piece of lead-covered wire is procured, and the outer lead covering is carefully removed so that a small lead tube remains. The terminal tag is then inserted in one end of this, and the end of the tube is well hammered down on to this tag. Similar treatment is applied at the other end of the tube in which the wire to be connected to the terminal tag is inserted.

A good and permanent electrical connection between wire and tag is thus effected. For aerial and earth wires and for loudspeaker connections there is nothing to beat the certainty of this method of connection.

It has just one disadvantage though. If the wire is continually moved about from place to place, the time will come when the wire will break away at the place where it is pinched by the lead tube.

Moral, therefore; only employ this type of connection for wires which are to remain **permanently** in some situation.

An A.C. Power Pack

A DISCUSSION OF GENERAL DESIGN OF BATTERY ELIMINATORS FOR ALL-MAINS OPERATION

The Transformer and Rectifier

THE first step in the construction of a Power Pack is to make careful and definite consideration of the valves to be used in the receiving set. When a conclusion has been arrived at, the rectifier valve to use may be decided upon as well as the requirements of the transformer. Some constructors will prefer American valves, others British and Dutch valves; some may even consider that best results will be attained by using a combination of the diverse types of valve obtainable in New Zealand. It will accordingly be realised that it would be an impossible task to attempt to describe here the many kinds of power pack likely to be required by amateur constructors. We shall therefore take a particular power pack and endeavour to describe the factors influencing its design in such a way that it will be not a difficult matter for the reader to construct an eliminator to suit his own requirements.

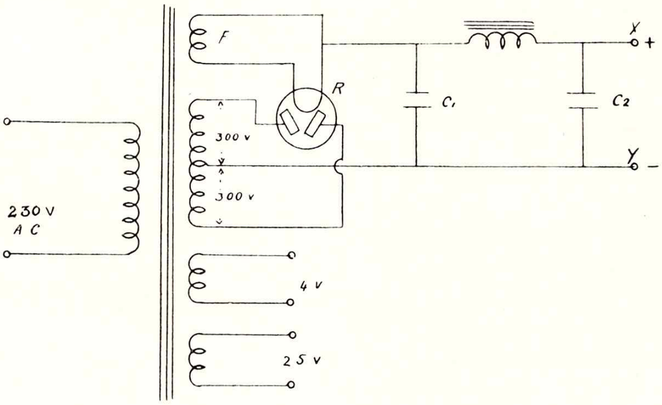


Fig 1. Rectifier and Filter.

THE TRANSFORMER AND RECTIFIER

For the particular eliminator to be described, the writer ahd in mind the use of an English S.G. valve, Osram MHL4 as detector, and E409 and UX-245 as radio amplifiers. Reference to valve manufacturers' tables showed that with 60 volts on the detector valve plate and maximum plate voltages applied to the other valves, a current of 50 milliamperes would be drawn from the high voltage side of the rectifier. The highest plate voltage is to the 245-valve and would be 250, but making provision for 30 volts bias would call for an output of 280 volts at 50 milliamperes. The eliminator being for experimental purposes, it was decided finally to have the transformer wound for a 300-volt output and a maximum current of 100 milliamperes.

Choice had next to be made of a suitable rectifier valve, and in view of the possibility of 100 mA. being taken the UX-280 type was selected. However, for smaller currents of 50mA. or less, a number of other valve rectifiers are available. For the 280-rectifier a filament winding giving 5 volts at 2 amps. must be put on the transformer. This winding is centre-tapped if connection is made as in Fig. 2, while to illustrate another possibility Fig. 1 shows the connection when the winding has no centre tap.

For the case under consideration, two other secondary windings were required on the transformer, viz., 4 volts at 3 amps. for the radio-frequency, detector and 1st audio valves, and 2.5 volts at 1.5 amps. for the 245 valve. The former winding may or may not be centre tapped and reference to our A.C. sets will show the filament connections as made in the two cases. If the last audio frequency valves is of the 4-volt directly heated type, it is desirable that a special secondary winding be made for use with it. Hence the final result is that the transformer has four secondary windings as follows:—

(a) High-voltage secondary giving 300 volts on each of the centre tap.
(b) Secondary winding for filament of the rectifier.
(c) Secondary winding for filaments of r.f., detector and 1st audio valves.
(d) Separate secondary windings for filament of last valve if directly heated, even if it operates on same filament voltage as valves in (c).

Reference to the article elsewhere on transformer construction will enable details of the windings to be worked out. Alternatively, the constructor may have the transformer built to his requirements by any of the advertisers in this journal.

In passing, it may be noted that the combination of valves mentioned above, viz., one r.f. detector, and two-audio valves is not suggested to be ideal. In fact a very much better arrangement from all points of view except that of simplicity of construction, would be the use of two r.f. detectors, and one audio valve.

THE FILTER

The rectified A.C. must be smoothed by means of a suitable filter system and generally the "brute force" type of filter shown in Fig. 1 will sufficie. This consists of an iron-core choke of inductance 20-30 henrys and capable of handling the maximum current of 50 mA. Condensers C_1 and C_2 complete the filter. When loads on

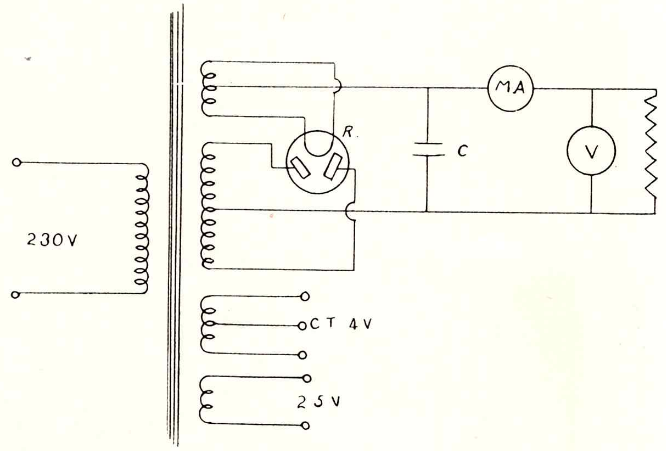


Fig. 2. The circuit for obtaining a voltage current curve for a B-eliminator.

the eliminator are light the voltage between the wires from the rectifier may become nearly 50 per cent. higher than the 300 volts fixed as the output voltage. The filter condenser should therefore be capable of withstanding 450 volts and should be of the type tested at 1000 volts. The two condensers should each have a value of not less than 2 mfds. In extreme cases where hum from the set is the result of imperfect smoothing, the condensers C_1 and

C_2 may well be of the electrolytic type giving a capacity of 8-12 mfds. each.

VOLTAGE, CURRENT CURVES

The voltage available between the output terminals is too high to be applied to the r.f., detector and first audio valves. It is therefore necessary to insert resistances in the leads to the plates of these valves in order to reduce plate voltage to the proper value. The correct values of these resistances can be determined by easy calculation provided that the voltage outputs from the rectifier at different current loads are known. The alternative to this is to place in each plate lead variable re-

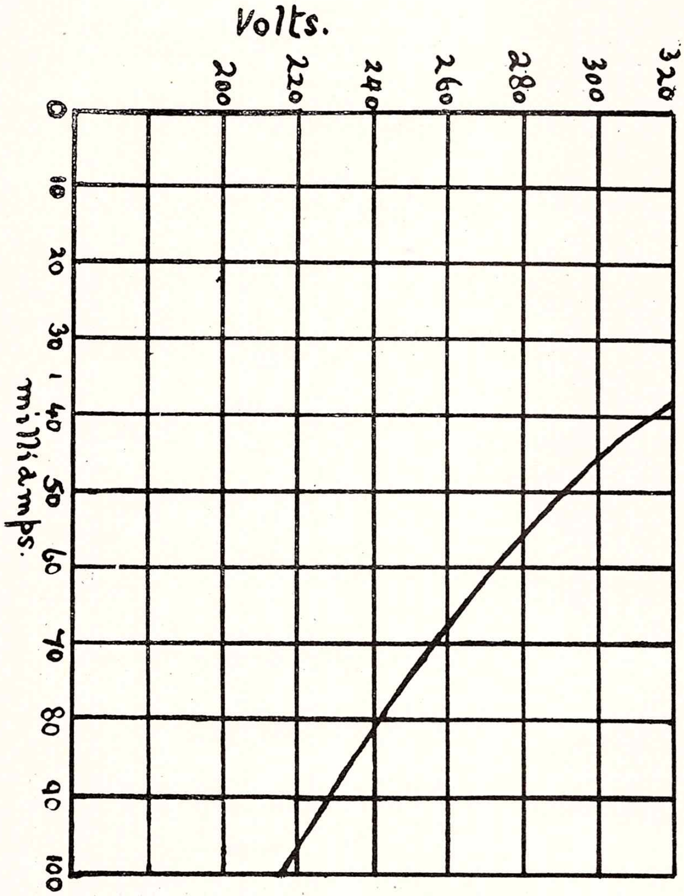


Fig. 3. Graph voltage, current for eliminator described in text.

sistance—capable of handling the power in each case—and adjust them by trial until the resistance is at its highest value consistent with good results. The most satisfactory method, however, is that mentioned first.

To obtain a voltage, current output curve for this power unit under consideration, the apparatus was connected up as in Fig. 2. The transformer, a "Well-mayde" built to the writer's specifications, was used in conjunction with a National 280-valve. In the figure, C represents the first filter condenser of 2 mfds., mA a milliammeter reading 0-100 milliamps., V a high-resistance eliminator voltmeter of 0-400 volts, S a variable resistance having a maximum resistance of 50,000 or 100,000 ohms and capable of handling a power of at least 20 watts. Of course, for eliminators giving smaller outputs the ranges of the measuring instruments could be considerably smaller.

The curve obtained from the measurements is shown in Fig. 3.

CALCULATING SERIES RESISTANCE

We shall now proceed to uitilise the curve for the purpose of calculating the sizes of the various voltage dropping resistances, and a reminder is given that whenever a current flows in a conductor volts are dropped in it, the magnitude of the voltage drop being determined by the size of the current flowing and the resistance of the conductor.

Thus

$$\text{Volts dropped} = \frac{\text{current in milliamps} \times \text{resistance in ohms}}{1000}$$

Now the choke to be used has a resistance of 220 ohms and when a current of 50 milliamperes is passing the volts dropped in it will

$$= \frac{50 \times 220}{1000} = 11$$

Reference to the curve of Fig. 3 shows that for a current of 50 milliamperes the output voltage is 290, but when the complete filter system is connected as in Fig. 1, 11 volts of this are dropped in the choke. The voltage available from the filter is therefore 279 which we may approximate and call 280 volts. This voltage is suitable for providing both plate and grid-bias voltages to the UX-245 valve in the last stage, but is much too high for the other valves of the set under consideration.

THE FIRST AUDIO VALVE

Suppose the valve for the first stage of audio-frequency amplification to be a Philips E409. Reference to the manufacturer's figures shows that the maximum plate voltage is 150 volts, while with this voltage applied the plate current is 12 milliamps and the grid bias should be 9 volts. The total voltage to be available at the receiving set for this valve will accordingly be 159. Now 279 volts are available between the points X, Y, Fig. 1. Between X and the plate of the valve there will be required to be inserted a resistance carrying 12 milliamps of such size as to drop

279 — 159 = 120 volts. Hence by formula

$$\text{Resistance in ohms} = \frac{\text{volts to be dropped} \times 1000}{\text{current in milliamps}}$$

$$= \frac{120 \times 1000}{12} = 10{,}000$$

Therefore in series with the positive output lead there must be inserted a resistance of 10,000 ohms. This should

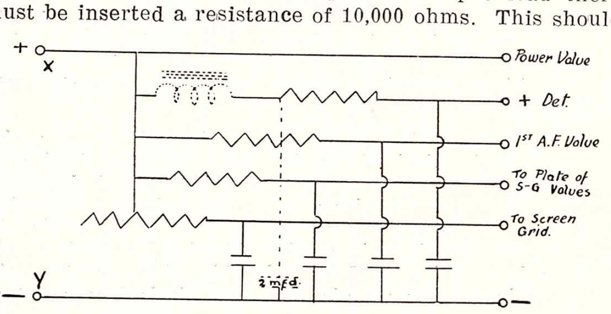


Fig. 4. Method of connecting resistances to points X, Y, of Fig. 1. The by-pass condensers ore each 1 mfd. For values of resistances see text.

be of wire-wound type capable of carrying a current of at least 12 milliamps. This resistance must be by-passed with a 1 mfd. fixed condenser having a working voltage of at least 160. The method of connection is shown in Fig. 4.

It may be mentioned in passing that where the value of the resistance does not work out in round figures as in the above case, choose the next highest value of resistance obtainable.

THE DETECTOR VALVE

To apply 80 volts to the detector valve at 2 milliamps., it may be calculated as above that a series resistance of 100,000 ohms would be suitable with this eliminator. This resistance must also have associated with it a by-pass condenser of 1 mfd. capacity.

In cases where hum is experienced it will be advantageous to insert in the lead to the detector plate a separate choke suitably by-passed with a 2 mfd. condenser tested at high voltage as shown dotted in Fig. 4 A choke used here need not be rated to carry high currents; up to 7 milliamps will be ample. The cheap and compact Ferranti type B3 choke is excellent for this purpose.

THE SCREEN-GRID VALVE

A screen-grid valve is fed from a separate terminal of the eliminator. If the valve is to have a maximum plate voltage of 150 applied the plate current will be about 3 milliamps. The series resistance required may be calculated to be about 44,000 ohms. Again, this resistance must have associated with it a by-pass condenser of capacity 1 mfd.

The voltages applied to the screen-grid is in general about half that on the corresponding plate and the best arrangement for getting the required voltage is by incorporation in the power pack of a variable resistance of say, 2000-100,000 ohms. The best value for most sensitive reception may be found by trial. This variable resistance could be made to serve as an excellent volume control, but it should be noted that too high a voltage applied to the screen-grid of a valve will materially shorten its life.

SOME GENERAL POINTS.

Some details have been given for the components of a particular power back. It is not anticipated that many constructors will require an eliminator exactly of the type described. With the multiplicity of valve circuit arrangements in use to-day the number of possible combinations is large. It has therefore been thought advisable to show the general method if working out eliminator design and leave it to the individual to make necessary calculations to meet his own case. For similar reasons it is impossible to give actual constructional details of the power pack although some general hints are given below.

Various valves and other components have been mentioned by name in the course of this and other articles. It is not suggested that these parts are the only suitable ones; they are mentioned because they have been actually submitted to rigid test and found satisfactory. They have been tried out because facilities for such tests have been made by the distributors.

CONSTRUCTIONAL HINTS

1. The various voltage dropping resistances may be incorporated in the set itself instead of in the power unit as shown in some of our descriptions of A.C. sets.

2. When the components are got together they should be submitted to such tests as are easily carried out, e.g., condensers should be tested for insulation breakdown by the phones and battery method.

3. The components should be mounted first of all on an open baseboard and, after wiring, connected to the set to discover whether hum is present and additional chokes or condensers are necessary. Care should be taken to keep the hands away from the power unit when current is switched on or severe shock may result.

4. When the power pack is working satisfactorily a final layout of components should be thought out and the whole unit reassembled, this time within an iron case. Care must be taken to provide ample and adequate ventilation as the rectifier valve becomes very hot when the eliminator is in use. The iron case must be earth-connected as an essential measure of safety.

SOME AERIAL PROBLEMS

THE question is often asked whether it is possible for two receivers (for example, in neighbouring houses) to be operated from a single aerial without interference with one another, and also whether two aerials can be used satisfactorily when they are close together, or when one of the aerials is in effect a prolongation of the other, with an insulator in the centre. It is obvious that readers raising these points are desirous of co-operating with a neighbour and making convenient arrangements with regard to the erection of aerials.

As regards working two receivers from one aerial, although this is theoretically possible and, in fact, is actually done in many commercial cases, it is not to be recommended for amateur reception. In the first place, unless the two receivers are of exactly the same type, there is considerable likelihood of complications, owing to the relationship of the earth to the receiver. For practical purposes it is better not to attempt to operate two different receivers on the one aerial.

As regards two aerials in line with one another, this also is an arrangement which is not to be recommended, as, although the aerials are theoretically separate from one another, and can, in fact, be turned quite separately on different receivers, it is almost certain that there will be interference between them, and if a powerful set is connected to one aerial it is probable that a large amount of absorption may take place from the other one.

In the case of two neighbouring aerials, it is better to keep these as far away from one another as is conveniently possible. It would be better still, of course, to arrange them so that they should not be parallel to one another, but this will not generally be practicable, as the most convenient direction for the one aerial will most probably also be the most convenient direction for the other one.

A Grid Bias Eliminator

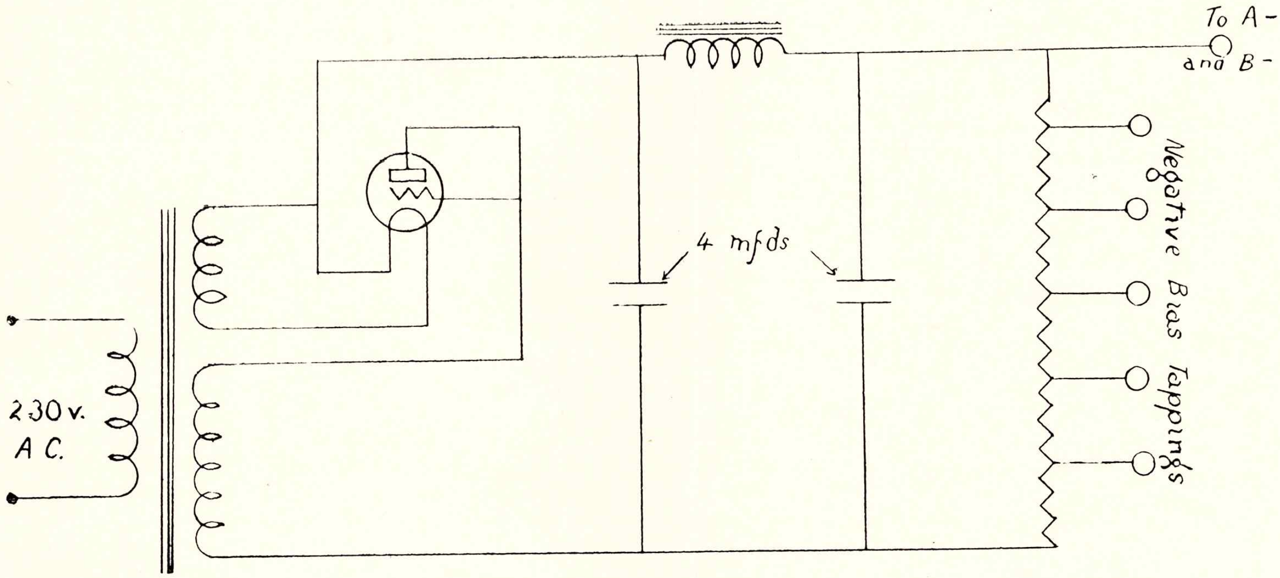


Fig. 1. Theoretical Diagram of a Grid Bias Eliminator

A simple method of providing for grid bias potentials utilising some discarded components.

THE listener with an A.C. supply in his home is fortunate in that the business of battery elimination can be carried out readily, with the added advantage that running costs are reduced to a minimum.

A grid bias eliminator may be built utilising an old three-electrode valve whose emission is no longer good enough for its conventional use in a receiving set. The connections for such an eliminator are shown in Fig. 1. The choke may well be the secondary of an audio transformer, one with the primary winding burnt out will serve

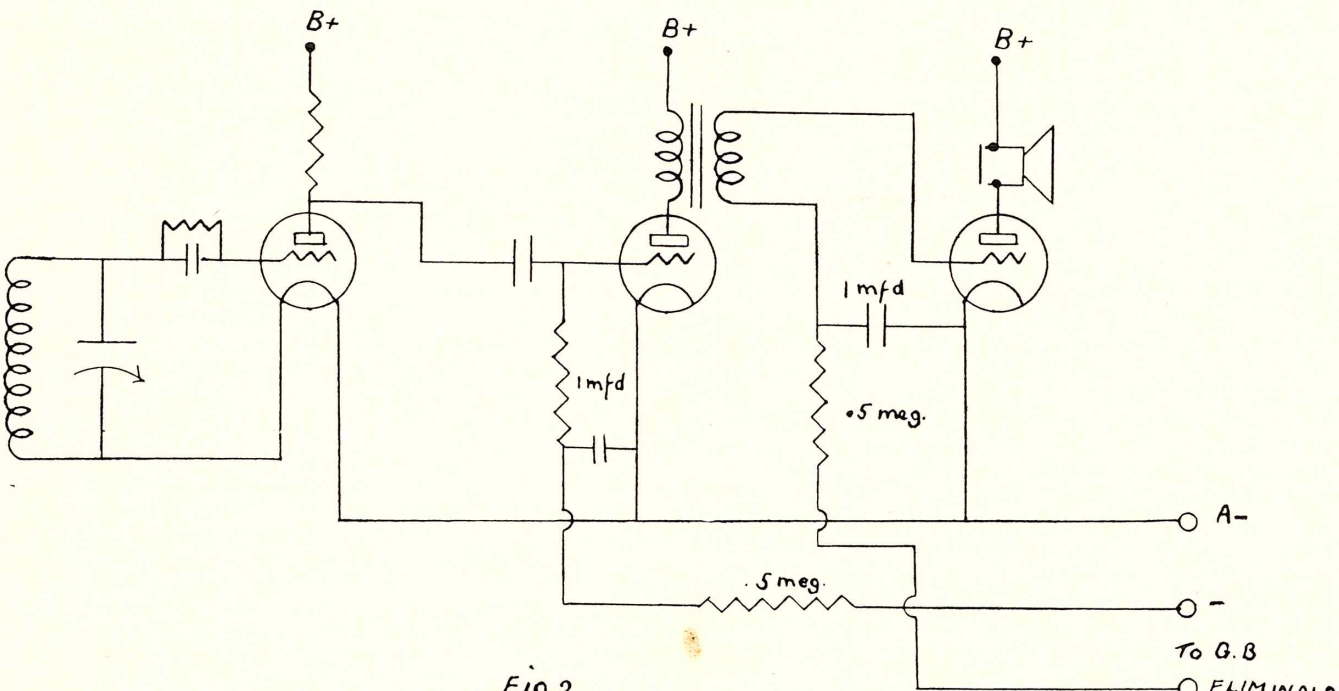


Fig. 2. Avoiding interstage couplings; filters for grid circuits.

nicely. The resistance acting as a potential divider to supply the biassing voltages may be of a type between 50,000 and 100,000 ohms, the number of tappings depending upon the number of valves to be biassed.

The mains transformer will need to be constructed as described elsewhere and the two secondary windings devised to supply (a) the correct filament voltage for the rectifying valve, (b) some 50 volts or more depending upon the maximum bias required for the set.

It will be noticed that the grid and plate of the valve are connected together.

DECOUPLING THE CIRCUITS

If hum is experienced it will be desirable to decouple the various grid circuits connected to the bias eliminator. The method of accomplishing this is shown in Fig. 2 for conventional two-valve amplifier having one stage of resistance-capacity coupling. The filtering is carried out in each case by means of ½-megohm resistances of the grid-leak type and 1 microfarad by-pass condensers. There is a good deal of latitude in the values of these components, but those suggested are satisfactory in practice.

The Superheterodyne Receiver

A SIMPLE EXPLANATION OF THE ACTION OF A HIGHLY SELECTIVE RECEIVING SET

A FEW years ago it was the ambition of every amateur radio constructor to own a "Superhet" which was considered to be the last word in receiver design. The superhet of those days used a large number of valves, nine being quite common while some had as many as twelve. Many of the home constructed sets would not work at all while others were amazingly sensitive covering tremendous distances with even a small loop aerial. With an outside aerial the static and other electrical sources of noise were picked up over large distances so that satisfactory reception of distant broadcasts was frequently impossible, a set, then, almost too sensitive for good reception. These sets were, in addition, a prolific source of howling valve interference and their use was forbidden except with a loop aerial.

THE BASIC SUPERHETERODYNE PRINCIPLE

The superheterodyne idea, devised by the American radio-engineer, Edwin H. Armstrong, is the exact opposite of that of every other kind of set. Normally, one tunes the radio-frequency amplifier to the wavelength of the signals being received, readjusting all the tuning controls for each station. With the superhet, the amplifier is set once and for all to a fixed frequency, and the frequency of the received signal is altered to suit the amplifier. Since one valve at least—and more usually two—must be provided for the sole purpose of effecting this frequency change, the superhet must inevitably be a little extravagant in valves, although, with modern valves, six or seven would very comfortably provide long-range frame-aerial reception.

In the days of the popularity of the superhet, amplification at high frequency was an unsatisfactory business owing to instability on wavelengths below about 750 metres. On wavelengths from 3000 metres upwards the difficulties were much less acute, and real amplification was readily obtainable. The superhet was therefore useful as it changed the received signal to a frequency that could be amplified effectively even with the imperfect apparatus of the time.

The steady improvement in valve characteristics and the appearance of the screen-grid valve, combined with investigation of problems of radio-frequency circuits, gradually made it possible to amplify signals at their original frequency so that the advantages of the superheterodyne receiver became of less simportance, while its defects, which were many, became correspondingly more obvious. Accordingly, the superhet has taken a back seat during the last few years for the excellent reason that almost equivalent sensitivity, with a much higher standard of quality in reproduction, could be obtained with the expenditure of fewer valves by using straight radio-frequency amplification of the signals on their original wavelength.

In the light of the improvement of valve design attention has again been directed to the superhet and it is possible to design a superhet free from all the defects attributed to the earlier type. Many commercial sets of this type are being manufactured now in America due to the fact that the Radio Corporation of America is now for the first time permitting its licensees to use the superhet patent. It would seem then that within the next year great progress will be made in the design of superheterodyne receivers. Should this anticipation be realised superhets for home construction will be featured in our 1932 Annual.

AMPLIFIERS

A Low-Power Amplifier

The requirements of radio constructors as regards amplification following the detector valve or for gramophone work vary considerably, but the general demand is for the reproduced music to have about the same loudness as the ordinary gramophone. For such purposes the power amplifier about to be described should prove suitable.

THE D.C. AMPLIFIER

In Fig. 1 is shown the ordinary schematic diagram for a two-valve amplifier using with a radio set a stage of resistance-coupled amplification followed by a conventional transformer-coupled stage. This arrangement is intended for battery operation, although the B-battery may be replaced successfully by a B-eliminator of proper output.

Fig I

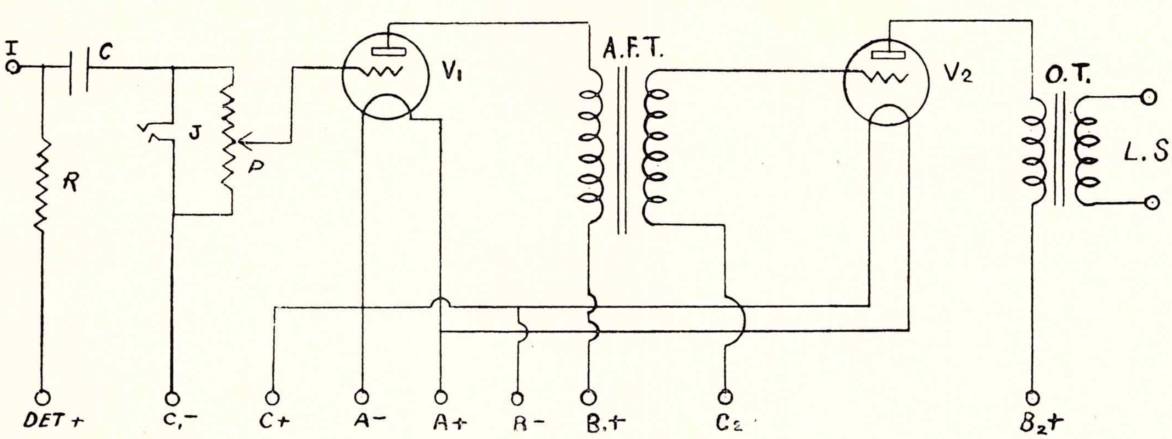


Fig. 1. A low-power D.C. Amplifier.

The circuit as depicted could be used to follow the detector valve of a receiving set, in which case the terminal I is connected to the plate of the detector or to the radio-frequency choke if reaction by the usual condenser-tickler combination is employed. For gramophone operation the pick-up is plugged into the jack J. The components to be used are :—

C—Fixed condenser of capacity .01 mfd.
R—Fixed resistance, 100,000 ohms, wire-wound.
P—Potentiometer, 500,000 ohms to act as volume control.
A.F.T.—Audio-frequency transformer about 3 to 1 ratio.
O.T.—Output transformer to loud speaker.

The valve V_1 should be of the type about 6000 ohms impedance and amplification factor as high as possible for general work, e.g., Osram DEP .410.

The valve V_2 should be a power valve of impedance about 2000 ohms.

The correct valve voltages are applied to the various termnials shown. The detector plate voltage is connected to DET +. The plate voltage of V_1 should be the maximum recommended by the manufacturer and is connected to B_1 +. The grid bias recommended for this voltage is connected to C_1 —. The voltages for the valve V_2 are applied to the corresponding terminals.

THE A.C. AMPLIFIER

In Fig. 2 is shown the corresponding A.C. amplifier for complete operation from the mains.

At the right is shown the mains transformer with its various secondaries. The valve V_3 is the rectifier of a type to give an output suitable for the valves to be used. The high voltage winding should give a total voltage equal to the sum of the voltages applied to the plate and the grid of the valve V_2. A filament winding is required to incandesce the filament of the rectifier valve. There are in addition two other filament windings, one being used for each valve. The use of two separate filament windings is essential where valves of different filament voltages are to be used, but they are desirable in any case for the elimination of hum and the simplification of grid-biassing problems. The high-voltage and the filament windings for V_1 are shown centre-tapped with a connection to earth. All the earth connections in the diagram are indicated by the letter E. The high voltage supply is smoothed by a filter unit consisting of a choke L and condensers C_4, C_5, and reference should be made to the article on A.C. power packs for the values of these components.

THE VALVES

The valves to be used should be determined by the constructor. To make the grid biassing easy V_1 is shown as a valve of the indirectly heated cathode type and was an E409 in the amplifier built for the purposes of this article. The valve V_2 was a UX-245, as this valve works best with the average American dynamic speaker. For the latter valve it was necessary to supply a total voltage of about 300, and, as the valve V_1 takes a maximum of 150 volts, the output from the rectifier must be connected to the plate of V_1 through a series resistance R_1. This resistance was calculated to have a value of 10,000 ohms. A by-pass condenser C_2 of capacity 1 mfd and working voltage of 250 must be inserted as shown.

OBTAINING GRID BIAS

To bias the grids of the two valves resistances R_2 and R_3 are required.

For an E409 valve with 150 volts on the plate the manufacturer states that the current through the valve is 12 milliamps when the correct bias of 9 volts negative is applied. Now the function of the resistance R_2 is to cause a voltage difference between grid and cathode of 9 volts while at the same time the current of 12 milliamps will flow through it. As mentioned elsewhere in this journal

Volts dropped = current in amps. x resistance in ohms, or the rule may be stated as follows :—

$$\text{Resistance in ohms} = \frac{\text{Volts to be dropped}}{\text{Current in amps.}}$$

so that in our case

$$R_2 = \frac{9}{.012} = 840 \text{ ohms (approx.)}$$

The nearest values to this which may be obtained readily are 750 and 1000 ohms. The latter value should be chosen as this will make the bias somewhat higher than 9, a better procedure than to make it lower.

To allow for the 9 volts bias the value of R_1 should be made such that 159 volts are applied to the plate of V_1.

The resistance R_2 is by-passed by a fixed condenser of 1 mfd. capacity.

If the valve V_2 is a UX-245 best results will be obtained with 250 volts on the plate and 50 volts grid bias when the current through the valve will be about 33 milliamps. By formula, then,

$$R_3 = \frac{50}{.033} = 1500 \text{ ohms (approx.)}$$

The resistance R_3, by-passed by a 1 mfd. condenser, is connected to the centre of a centre-tapped resistance, R_4, of 20 ohms.

The above method of biassing the grids of the valves is greatly to be preferred to the practice sometimes adopted of using a grid-bias battery where the rest of the set is operated from the mains. The grid-bias battery slowly runs down and with the plate voltages remaining steady the life of the valve is materially reduced.

Owing to the difficulty of not knowing what valves will be used no lay-out diagram is given for the amplifier. The unit is built simply and no special precautions as regards placing of parts are necessary. It is desirable, however, that all the apparatus be enclosed in an earthed metal case to remove all possible danger from shock.

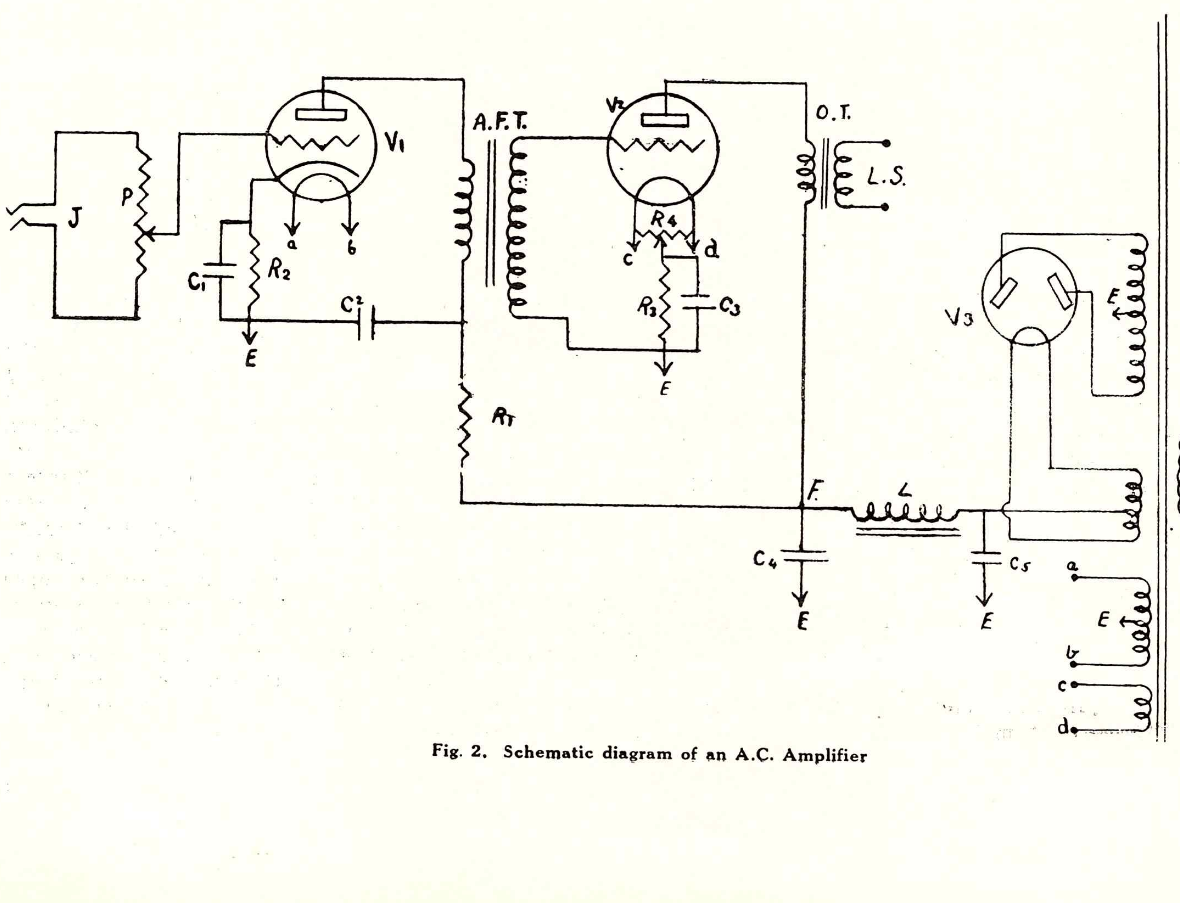


Fig. 2. Schematic diagram of an A.C. Amplifier

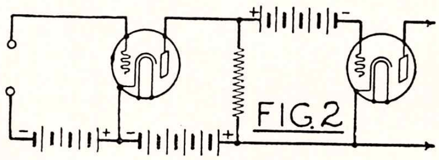
The Loftin-White Amplifier

THE need for a thoroughly efficient audio amplifier at a reasonably low cost has been experienced by so many radio enthusiasts that it is by no means surprising that we have received numerous enquiries regarding the Loftin-White amplifier which fills this need and can be built up of standard parts. Our answers to individual enquiries are essentially brief and we are unable to supply detailed diagrams with these answers. We are pleased, therefore, to avail ourselves of the opportunity to reproduce an article below by Mr. Sylvian Harris, for which we are indebted to "Radio Design." This brief article, written in a simple and straightforward manner to allow it to be understood readily by every wireless enthusiast, gives all the description required regarding this audio amplifier, and we are convinced that readers, by following carefully, the instructions and diagrams given below, will quickly be able to solve any little problems which the amplifier may have presented to them.

Much has been written concerning the Loftin-White direct coupled amplifier, and there probably remains to be written yet much more. This amplifier has quite a few admirable features. At the same time there are certain things, in connection with it, which must be borne in mind and of which the experimenter must not lose sight when working with it.

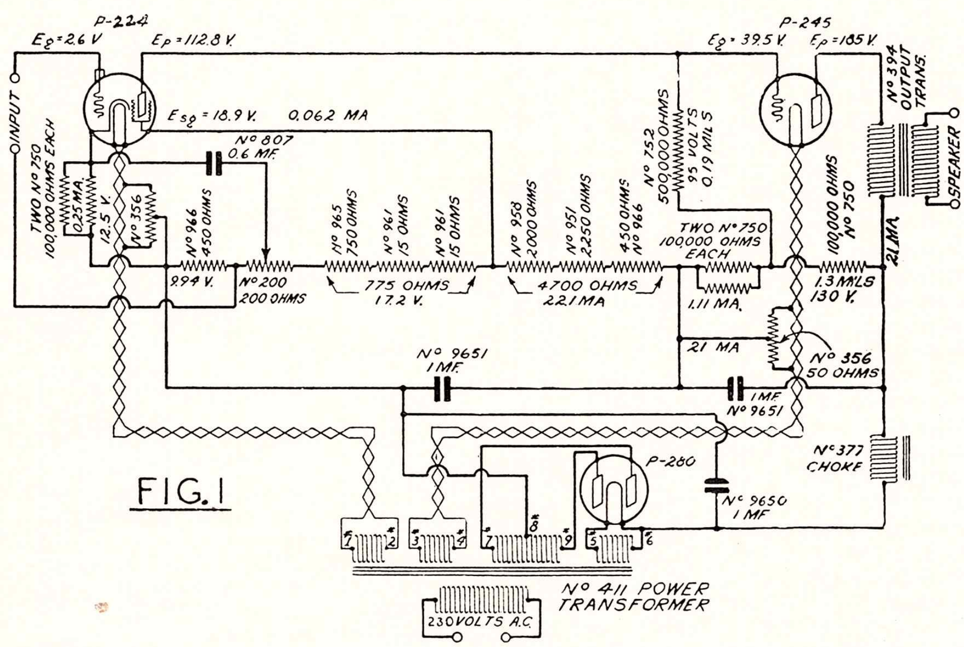
The circuit of the Loftin-White amplifier is shown in Fig. 1. It is seen that the elementary principle of the amplifier is exactly the same as that of the well known resistance-capacity coupled amplifier. The voltage drops produced by a signal in a resistance in a plate circuit of the first tube is impressed directly upon the input (that is, the grid and cathode) of the second tube. This differs from the usual resistance-capacity coupled amplifier in that in the latter, this voltage drop is impressed upon the input of a second tube through a coupling condenser. The coupling condenser produces a loss of voltage and also introduces a certain amount of distortion, due to the fact that condensers transmit lower frequencies with difficulty.

These objections are removed in the Loftin-White system. Directly coupled circuits have been used in the past for special purposes, and in general required a large "C" battery connected to the grid of the second tube in order not only to furnish the bias for that tube, but also to balance out the large positive voltage coming from the plate circuit of the first tube. The idea is illustrated in Fig. 2. Such an arrangement was necessary until the technique of supplying radio receivers with power from commercial lighting



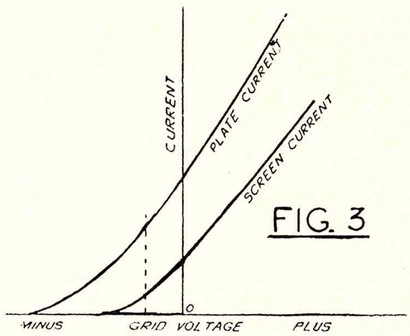
The fundamental circuit of the direct-coupled audio amplifier

mains was developed. In addition to this, there was required the development of the indirectly heated type of tube so that the cathodes of the tubes could be isolated and operated at voltages independently of each other. Furthermore, there was required a knowledge of how to handle the various hum voltages arising from the rectifier which was used. to supply power to the system. The filter circuit, used for hum suppression, involving as it does quite large capacity and inductance in the various circuits, is another costly items and any efforts to reduce this cost are certainly directed to a worthy cause.



The complete hook-up of an experimental Loftin-White Amplifier. Note carefully how the various resistors are connected.

An amplifier which can accomplish all these things at one and the same time, that is, increased amplification, reduced cost and improved quality, is a thing which is much to be sought after and desired. The design of the Loftin-White circuit is directed along these lines. The elimination of the coupling condenser results in better fidelity of performances; the employment of the more sensitive screen-grid tube results in greater amplification. As to the matter of improvement in hum, it appears that this is at the present time an open question, for, assuming same hum voltage at the source of potential, it should make little difference in the resulting hum at the loud speaker as to whether many tubes of low amplification are used or few tubes of high amplification are used. A certain grid swing is required at the input of the power tube, in order to load it up. A certain modulated R.F. voltage is applied to the input of the detector tube, it is clear then that, regardless of what means of amplifying this signal may be used, the amount of amplification required must remain the same. Hence, whatever hum disturbance may be present in the cathode circuit of the detector, referring particularly to the bias resistor, it must be subjected to the same amplification which we have in our usual amplifiers.



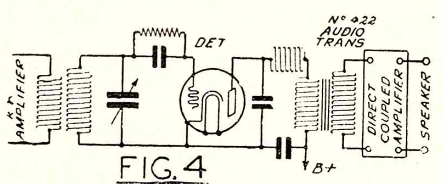
Typical characteristic curves of the screen-grid valve

Of course, since there are fewer stages there are fewer sources of hum voltage to worry about, so that if the hum voltage introduced into the cathode circuit of the first stage is properly balanced out, it may be possible to secure a sufficiently low hum at the speaker without employing a filter circuit as costly as the present-day filters. There is a distinct advantage gained in this type of amplifier in the absence of equipment which can cause hum troubles by induction, such as transformers.

The circuit of Fig. 1 is one which has been found to work satisfactorily by this writer. The values of the resistance are indicated in the diagram. The voltage was obtained from a Pilot No. 411 power transformer operating into the filter circuit shown in the diagram. The resulting currents through the resistance and the voltages applied to the tube elements are also indicated. These voltages refer to the difference of potential at the tube terminals, that between plate and cathode, grid and cathode screen and cathode. They cannot be measured very accurately and in some cases, not at all. The usual voltmeters, or even the high resistance voltmeters require a small current to operate them which is sufficient to disturb the operating condition of the amplifier when making measurement. Consequently it is necessary to determine the voltages in the circuit by measuring the currents in the various branches and multyplying them by the resistances of the branches. For example, the current through the 100,000 ohm resistor was found to be 1.30 milliampere, hence the voltage drop in that resistor is 130 volts. The current in the 500,000 ohm resistor is 0.19 milliampere, since the voltage drop in it is 95 volts. The current in the 50,000 ohm resistor is therefore 1.30 minus 0.19, or 1.11 milliampere.

Proceeding in this manner the currents and voltages indicated in the diagram can be calculated for the entire circuit. The bias voltage on the P-245 tube is the difference between the drop in the coupling resistor and the 50,000 ohm resistor in the voltage divider. That is it is equal to 95 minus 55.5, or 39.5 volts. The voltage between the plate and cathode of the P-245 can be measured with sufficient accuracy by means of a high resistance voltmeter. The voltage supplied to the screen-grid tube are indicated in the diagram as being 112.8 volts between the plate and cathode, 18.9 volts between the screen and cathode, and 2.6 volts between the grid and cathode. The biasing voltage on the first tube is the difference between the voltage drop in the cathode of the P-245 can be measured with sufficient accuracy by means of a high resistance voltmeter. The voltages applied to the screen-grid tube cathode resistor and that in the 450 ohm resistor, viz., 12.5 minus 9.9 or 2.6 volts. The values given in the diagram for the various resistors have been chosen so that there is little variation in the plate currents of the tubes with signals of different strength. A certain amount of variation of screen current must be tolerated, however, for the reason that tube voltages which cause the tubes to operate or the linear portion of the plate characteristic will generally cause the operating point to fall near or at the bend of the screen characteristic.

This can be seen by referring to Fig. 3, which shows the plate current grid voltage curve and the screen grid voltage curve. This variation of screen current, however, will not result in distortion of any appreciable magnitude since it does not appear in the output circuit of the tube, that is the plate circuit. This little sidelight on the operation of the screen grid may be of interest when considering this type of tube in the role of detector, e.g., a screen grid detector may cause variation of the screen current and a consequent variation of screen to cathode resistance. The plate current may therefore be modulated by this means and result in very efficient signal detection.



To use the Loftin-White Amplifier with a radio receiver, it is best to couple it to a regular detector through an A.F. transformer as shown here

THE REGULATION FEATURE

Referring to the circuit of Fig. 1, it will be seen that when, for any reason, an increase occurs in the plate circuit current of the 224 tube, the bias on the 245 will increase automatically. This will cause a decrease of plate current in the 245. The 245 plate current constitutes the major portion of the current through the 450 ohm resistor, so that when this current decreases the bias on the 224 increase, tending to maintain the 224 plate current constant. This is the regulation feature of this circuit about which much has been written. The circuit

shown in Fig. 1, using the values given, has been found satisfactory as a phonograph reproducer.

In attempting to apply the Loftin-White system to the rectification and amplification of signal voltages obtained from an R.F. amplifier, certain difficulties were encountered, which we must not fail to mention. Aside from the fact, which has been brought out by other writers, that changing the grid leak detector of a receiver into a " C ' bias detector (as is required of the first tube of Fig. 1) will considerably change the stability conditions of the R.F. amplifier. It is well-known that the low dynamic input impedance of the grid leak detector assists materially in stabilizing the R.F. amplifier, because of the damping effect which it has upon the tuned circuit connected to it. An R.F. amplifier which has been stabilized for such a condition may no longer be stable when the detector is changed to a " C " bias detector without making proper changes in the R.F. amplifier.

A DIFFICULTY

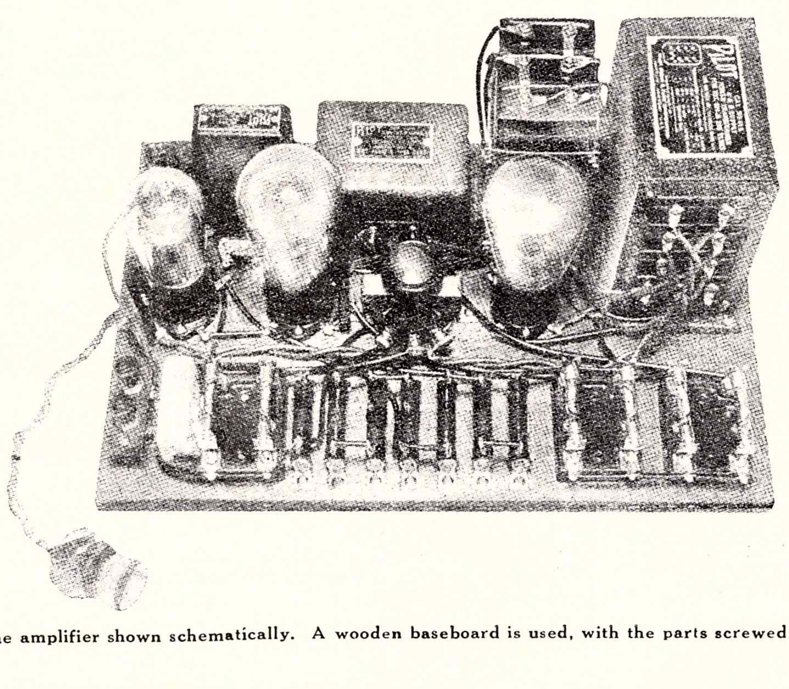
But aside from this, there is another difficulty which is far more serious: It is not possible properly to short circuit the radio-frequency component of the detector plate current by means of a by-pass condenser from plate to cathode, which we are so accustomed to doing. The reason for this is apparent when we consider that a condenser would be in parallel to the coupling resistor of ½ megohm ; e.g., the reactance of a .001 mf. condenser at 1,000 cycles is approximately 160,000 ohms. This consequently will act as a partial short circuit across the ½ megohm coupling resistor, and the high modulation frequencies will be lost. Without using such a by-pass in the plate circuit of a detector, large R.F. voltages will be passed through this tube and established in its place circuit. Three evils can result from this. If the impedance of the remainder of the system is sufficiently high, or, if a radio frequency choke is connected at the plate of the detector, the R.F. voltage developed there may be forced to feed back into the R.F. amplifier and result in a hopelessly unstable condition. Again the R.F. voltage at the plate of a detector may be passed on and amplified for the audio amplifier, resistance coupled as it is, may also act as an amplifier of R.F. voltages. This may cause a disturbance in the operating conditions of the 245 tube with consequent deleterious effects on the fidelity of reproduction.

Another feature of the detector, which militates against the use of the power tube of the direct coupled system as a detector, is the very feature which tends to make the system stable as an amplifier. A change of plate current is required in a detector as it is by reason of this that the tube rectifies at all. Consequently, the self-regulation of the system, brought out by the opposing effects of the voltage across the bias resistor of the 224 and that across the 250 ohm resistor, will considerably reduce the efficienty of rectification.

GOOD PHONOGRAPH AMPLIFIER

We have had, thus far, no success with the direct coupling system when using the first tube as a detector connected to an R.F. amplifier. We have, however, had sufficient success with the system as a simple amplifier to recommend it to those who are interested in the setting-up and studying of new circuits. For example, if we use the usual detector in our radio receiver, follow it by a transformer or the usual resistance capacity coupling, and then follow this by the Loftin-White system we have a very powerful system which will operate very satisfactorily. Or, if it is so desired, the Loftin-White amplifier can be built up as in Fig. 1 and used merely to operate on a phonograph pickup.

The layout shown on the preceding page can be duplicated very easily. The baseboard measures 9 x 14 inches and is one inch thick.



Layout of the amplifier shown schematically. A wooden baseboard is used, with the parts screwed down on it.

WIRE TABLES

A SET of wire tables is given here containing information likely to prove of value to the home-constructor of electrical apparatus.

Table I shows the connection between the Standard Wire Gauge (British) and the Brown and Sharpe (American) wire gauge. Wires purchased in New Zealand will almost always be S.W.G.

Table II gives information frequently sought when the length of coil former required is to be calculated. The space occupied by a particular number of turns of any wire likely to be used in a receiving set may be calculated easily. Note—D.S.C. represents double-silk covered and D.C.C. double cotton covered wire.

Tables III and IV give the resistance and current-carrying capacity of the resistance wires "Eureka" and "Nichrome," which are most likely to be used in the manufacture of resistances. The former is used is the rheostats, while the latter is used in electric soldering irons, radiators, etc. It will be noticed that the resistance of the nichrome wire changes appreciably with temperature. Temperatures are given on both the Centigrade and Fahrenheit scales.

TABLE 1

Diameters in Inches of Common Wire Gauges

No.	S.W.G.	B. & S.	No.	S.W.G.	B. & S.	No.	S.W.G.	B. & S.
4/0	.400	.4600	15	.172	.0571	33	.0100	.0071
3/0	.372	.4096	16	.064	.0508	34	.0092	.0063
2/0	.348	.3648	17	.056	.0453	35	.0084	.0056
0	.324	.3249	18	.048	.0403	36	.0076	.0050
1	.300	.2893	19	.040	.0359	37	.0068	.0045
2	.276	.2576	20	.036	.0320	38	.0060	.0040
3	.252	.2294	21	.032	.0285	39	.0052	.0035
4	.232	.2043	22	.028	.0253	40	.0048	.0031
5	.212	.1819	23	.024	.0226	41	.0044	
6	.192	.1620	24	.022	.0201	42	.0040	
7	.176	.1443	25	.020	.0179	43	.0036	
8	.160	.1285	26	.018	.0159	44	.0032	
9	.144	.1144	27	.0164	.0142	45	.0028	
10	.128	.1019	28	.0148	.0126	46	.0024	
11	.116	.0907	29	.0136	.0113	47	.0020	
12	.104	.0808	30	.0124	.0100	48	.0016	
13	.092	.0720	31	.0116	.0089	49	.0012	
14	.080	.0641	32	.0108	.0079	50	.0010	

TABLE 2

Data concerning Wires used in Receiving Set Inductances

S.W.G.	Ohms per 1000 Yards	—D.C.C.— Turns per inch	Yards per lb.	—D.S.C.— Turns per inch	Yards per lb.	Enamelled Turns per inch
16	7.46	13	28	14	29	15
18	13.27	17	46	19	48	20
20	23.59	22	78	25	84	26
22	38.99	25	128	32	138	33
24	63.16	30	202	39	222	42
26	94.35	36	293	47	329	50
28	139.6	39	422	56	474	61
30	198.8	44	570	66	664	72
32	262.1	50	721	75	886	83
34	361.2	54	940	85	1200	98
36	529.2	63	1273	102	1727	122
38	849.1			121	2690	143
40	1326,7			142	4000	180
42	1910.5			167	5491	211
44	2985			192	8103	253

TABLE 3

High Resistance "Eureka" Wire

Size S.W.G.	Resistance Ohms per lb.	Ohms per 1000 yds.	Approx. Amperes per 100°C 212°F	200°C 392°F	300°C 572°F
14	2.304	133.9	9.5	15	19.5
16	5.620	209.4	6.0	10.4	14.3
18	17.80	371.8	4.3	7.0	9.1
20	56.17	661.3	3.0	4.7	5.9
22	153	1093	2.2	3.2	4.1
24	403	1770	1.5	2.3	2.8
26	900	2645	1.01	1.68	2.1
28	1970	3914	.76	1.37	1.58
30	4000	5575	.59	1.00	1.25
32	6950	7350	.47	.81	.95
34	13174	10128	.37	.64	.75
36	28308	14840	.28	.48	.57
38	72856	23808	.19	.31	.40
40	177744	37184	.15	.24	.28
42	368480	53564	.13	.18	.23
44	900000	83664	.10	.14	.17
46	2845360	148764	.07	.10	.12

TABLE 4

High Resistance Nichrome Wire

Size S.W.G.	Approx. Resistance in Ohms per 1000 yards 200°C 392°F	400°C 752°F	600°C 1112°F	Approx. Amperes at 200°C 392°F	400°C 752°F	600°C 1112°F
14	289	314.4	344.3	10.5	16.5	25
16	425	494	538	7.1	12	18
18	808	879	957	4.3	7.7	11
20	1426	1590	1700	3.5	4.7	6.8
22	2360	2583	2820	2.2	3.5	5.1
24	3828	4187	4555	1.6	2.4	3.3
26	5720	6250	6870	1.1	1.9	2.6
28	8460	9250	10070	.93	1.4	2.0
30	12040	13170	14320	.68	1.1	1.6
32	15880	17360	18900	.55	.80	1.2
34	21880	23920	26100	.43	.63	.93
36	32200	35070	38380	.32	.49	.72
38	51400	56300	61270	.21	.34	.49
40	80200	87900	95700	.16	.24	.35

RECEIVING SETS

SOME GENERAL ADVICE

DIFFICULTIES of many kinds are experienced by home constructors of radio sets as the many letters received by our Query Department show. So varied are the faults which may arise with electrical apparatus, especially when built carelessly, that we are not surprised at many of the troubles which arise. Even in cases where every care has apparently been taken difficulty is sometimes found in obtaining good results from a receiving set even by the experienced constructor. We appreciate the fact that these difficulties do occur and we attempt to be of assistance to those who build our sets carefully. We are at loss, however, to understand the attitude of some of our correspondents, particularly those who fail in the construction of their first receiving set. The general procedure seems to be to pick out and build a fairly-complimated set, using, say, a screen-grid valve. No success is obtained, due probably to inexperience in set construction, so the set is dismantled and a more ambitious programme in the form of building a five-valve set is undertaken. Again inevitable failure; followed by frantic appeals, to our Technical Department. All of this could be avoided if the beginner would adopt a logical order to his experimenting.

The first step should be to build the simplest of our receiving sets, the two-valve battery type. With care success will be achieved, but this does not mean that a more complicated set should now be built. The amateur should, rather, use the set for a couple of months until he thoroughly understands its operation and any eccentricities it may develop. Next a three-valve set should be built and used for a while. Gradual progress in this manner to the more complicated type of set will mean that the constructor is storing up a good fund of radio knowledge which will enable him to tackle easily the building of any set representing the most modern practice in radio design. Any other method of procedure cannot but result in failure.

To encourage this method of home construction it has been our object to use in the simple sets apparatus which as far as possible can be incorporated in the larger sets, so that discarded components will be few.

Two Valve Battery Set

THE IDEAL RECEIVER FOR THE BEGINNER

FOR a first attempt at the construction of a receiving set the simplest possible circuit should be chosen and the two-valve type about to be described, while being easy to build, is capable of giving remarkable results. Reception from it on a loudspeaker is possible only with local broadcasting stations but on headphones the range will be surprising if constructed according to specifications.

THE CIRCUIT

The circuit as shown in Fig. 1 is one which has achieved wide popularity in New Zealand, particularly in all-wave sets, since it was presented by New Zealand Radio some years ago.. The adaptation of it as an all-wave set was fully described in our 1930 Handbook which should be consulted if it is desired to listen to short-wave broadcasts.

THE VALVES

The valves used may be of a 2-volt or 4-volt type with the arrangement shown, but other kinds may be used with suitable filament control rheostats. The new American 2-volt valves would be suitable and make for economy in the initial cost of batteries.

Where 4-volt valves are to be used the first valve should be the special detector type and the second a valve of moderate impedance, say 6,000 to 10,000 ohms with as high an amplification factor as possible.

THE COMPONENTS REQUIRED

The complete list of parts required for the construction of the set is as follows:—

V_1 and V_2—Valves as above.
Two valve sockets.
P.S.T.—Inductances as described below.
C_1—Variable condenser, capacity .00035 mfd.
C_2—Variable condenser, capacity .00025 mfd.
Two dials for the condensers.
S.W.—Filament switch.
C_2—Fixed condenser,, .00025 mfd. with grid-leak clips.
R—Grid leak, 3 to 5 megohms.
R.F.C.—Radio-frequency choke for ordinary broadcast band of wavelengths.
A.F.T.—Audio-frequency transformer of about 3 to 1 ratio
Bakelite, ebonite or dry wood panel.
Wooden baseboard, terminals, wire, screws.
Lead accumulator 2- or 4-volt, B-battery 90 volts, headphones, loud-speaker, single-circuit output jack.

THE INDUCTANCES

The construction of the three coils is shown in Fig. 2 the dimensions and number of turns being marked in. They are wound on a former, preferably ribbed ebonite, of 3in. diameter, the ends of the wire being taken through the inside to the scrws and soldering lugs as indicated.

Fig I

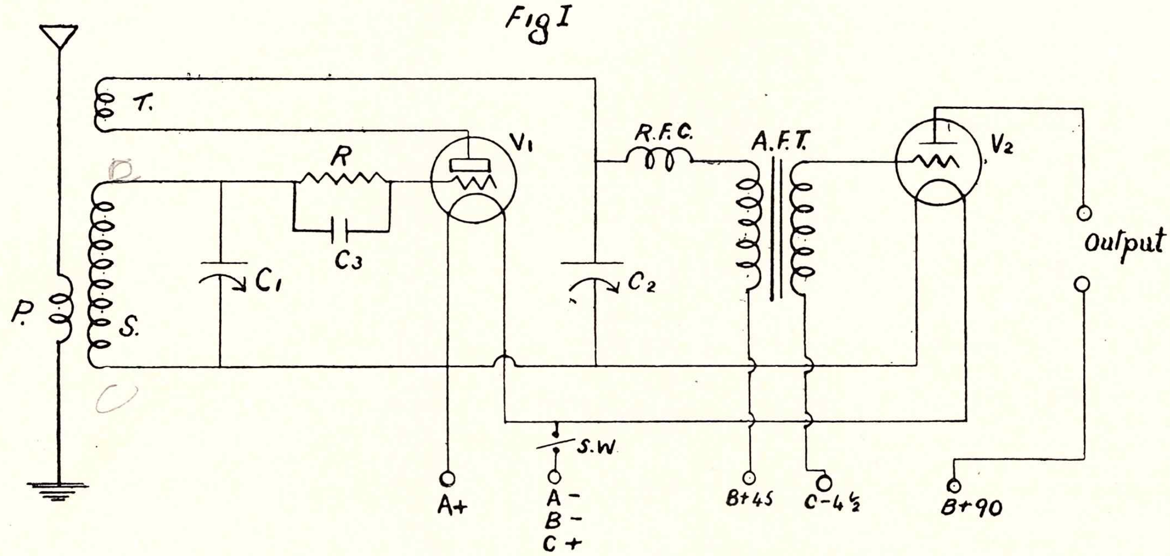


Fig. 1. The schematic Diagram.

These soldering lugs should be attached to the former in such positions as to make the wires to them as short as possible in the finished set, so that Fig. 3 should be consulted before the coils are wound. It is important to note that all the turns must be wound in the same direction.

The layout diagram of Fig. 3 gives a suggested method of mounting and wiring the various parts of the set. In

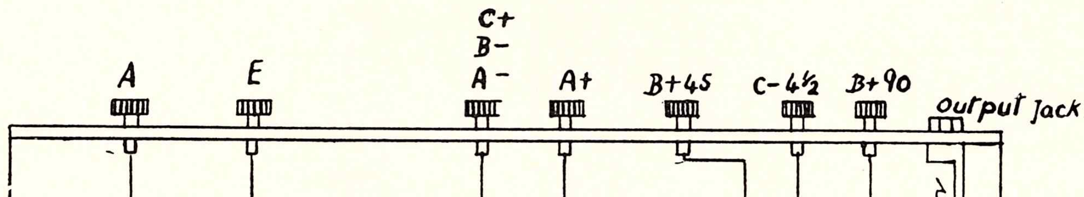


Fig.3

Fig 3. Lay-out of the two-valve battery set.

See P 172 1931 Radio Guide

order that either headphones or loudspeaker may be connected an output jack is shown; this could be replaced by two terminals if desired.

It will be noticed that the moving plates of the two conensers are connected to A+ so that if they are to be mounted on an earthed metal panel it will be essential to see that no earth connection is made to A—, otherwise the A-battery will be short-circuited.

OPERATING THE SET

After the set is assembed it will be necessary to check the wiring carefully in order to determine that connections are correct. The batteries and headphones are then connected.

Tuning of the set is simple and is carried out in the same manner as described for the S.G. short-waves receiver. Care must be exercised to see that the control of regeneration is smooth as reception of distant broadcasting stations will be made practically impossible if the set goes into and out of oscillation at all violently. The set should not be kept in an oscillating condition for any length of time when tuning in a station as interference with the reception of other listeners will be created. If you are unable to tune in the station within a couple of minutes then it means that the particular broadcasts are too weak to be heard on your set and no amount of juggling will remedy the trouble. Leave that station to others with sets capable of hearing it and give them a chance to receive it without the accompaniment of whistles and howls.

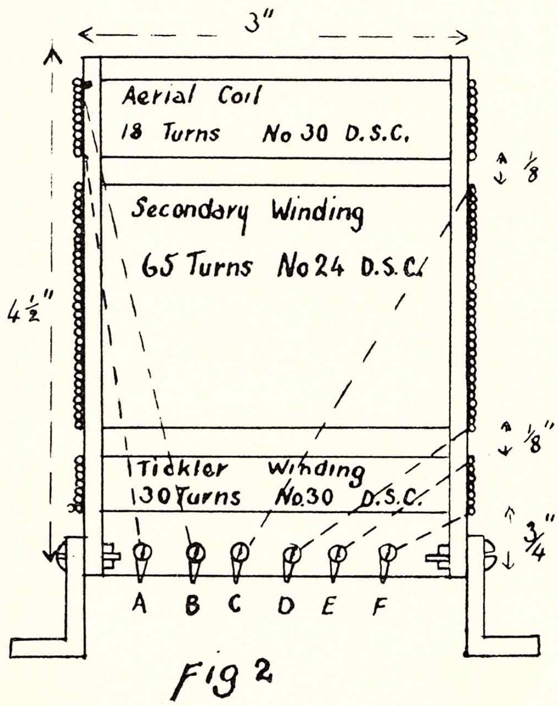


Fig. 2. The tuning coils.

WORTH TRYING

TO see whether an indoor aerial will answer costs so little and takes up so small an amount of time that it is well worth trying out. The only ingredients required are four miniature insulators (costing about a penny apiece), four nails, some string, and enough No. 18 double-cotton-covered wire to go round three sides of a room. To follow the directions for putting it up, draw on any old piece of paper an oblong to represent the plan of the room, marking the corners a, b, c, d, the letters running clockwise. We will suppose that the set is to stand close to the corner marked a. Drive a nail into the wall a d (or the picture rail, if there is one) about 12in. from corner a and another one 12in. from corner d. Drive the other two nails into corner b and corner c. All the nails should be about a foot below the level of the ceiling. Pass the end of your reel of wire through the insulator near a, then take it successively through those near b and c. Anchor it to the insulator near d. Go back to a annd putt the wire taut, which will cause the insulators to stand out from the walls. Allow a length sufficient to reach from the insulator at a to the aerial terminal of the set, cut off and make fast to this insulator. The job is now complete and the indoor aerial may be tried out. If your set is housed in a ground-floor room you may find it advantageous to erect the aerial in a first-floor room or in an attic, and to bring the lead-in through the floor and ceiling by means of a small ebonite tube.

It must be remembered that the inside aerial will not pick up the broadcast quite as readily as will the outside aerial; neither will it pick up static and other interference, however, therefore it is well worth the extra valve which some allow for the inside aerial. Yet much more than the cost of one extra valve is saved by eliminating the outside aerial; and the outside aerial is not only unsightly, but is also subject to the ravages of the weather and cannot be given attention as readily as can the indoor aerial, owing to the relative inaccessibility of the former.

The outside aerial served quite a useful purpose in the early days of broadcasting, inasmuch as it advertised to the world—or a small portion of it—the fact that the householder was a wireless enthusiast; but enthusiasts have become so numerous during the past few years that the ownership of a receiving set, or even an outside aerial carries with it no distinction to-day. Indeed, the introduction of the inside aerial has been responsible to no little extent for the rise in the number of set owners. While the outside aerial was considered the sole suitable method for taking the broadcasts many people refrained from purchasing sets in order to avoid the appearance of their homes.

The decline of the crystal and the rise of the valve not only made the use of the inside aerial greater, but its use also demonstrated the fact that it is much more selective than the outside aerial and not as subject to interference; that it was much more refined in reception as well as in appearance.

A Short Wave Receiver

CONSTRUCTIONAL DETAILS OF A RECEIVING SET FOR SHORT-WAVE WITH ONE TUNING CONTROL

RADIO-FREQUENCY amplification on low wavelengths, an impossibility until the advent of the S.G. valve, offers scope for the improvement of short-wave receiving sets at small additional outlay. How simple is the incorporation of a screen-grid valve is shown in Fig. 1, which represents a popular type of modern short-wave receiver.

THE COMPONENTS

The parts required for the set are as follows :—

V_1—4-volt S.G. valve.
V_2—4-volt valve of the special detector type.
V_3—4-volt valve suitable for first stage amplifier.
Four valve sockets.
C_1—Variable condenser of .00015 mfd. maximum capacity with vernier dial.
C_2—Variable condenser of capacity .00025 mfd.
C_3, C_4—Fixed condensers, capacity .1mfd of good manufacture.
C_5—Grid condenser of capacity .0001 mfd.
R_1—Variable resistance, 10,000 ohms maximum.
R_2—Filament rheostat.
R_3—Grid-leak, 5 to 10 megohms.
R_4—Fixed resistance of 100,000 ohms and holder, to eliminate "threshold howl".
R.F.C.—Radio frequency choke of 160 turns No. 34 D.S.C. wire on ½in. wooden former.
A.F.T.—audio-frequency transformer of high ratio.
S.W.—Filament Switch.
L_1 and L_2 . . . . . see text.
Terminals, Wire, etc.

THE VALVE VOLTAGES

Four-volt valves have been specified because with two of them it is possible to dispense with filament control resistances, but other types may be used successfully when filament voltage is adjusted to correct values. Suitable types may be chosen from the figures given in the valve table elsewhere in this issue.

The amplifier voltage connected to the terminal, AMP., should not be less than 90 volts and could with advantage be 135. The screen-grid voltage applied to the terminal , S.G., should be about one-half that applied to the plate of the valve. The detector voltage will be found suitable at about 45.

The value of the grid-bias voltage will depend of course, on the valve used and the plate voltage applied to the valve V_3. The best value will be found in our Valve Table.

THE TUNING INDUCTANCES

The coils L_1, L_2, are most conveniently wound and mounted on the bases of UX-type valves as shown in Fig. 2. Three sets of these coils will be required to cover the wavelengths of short-wave broadcasts, the number of turns being shown in the table below. The wave bands covered by each coil give any amount of overlap.

All the coils L_1 may be wound with No. 24 and the coils L_2 with No. 30 D.S.C. wire.

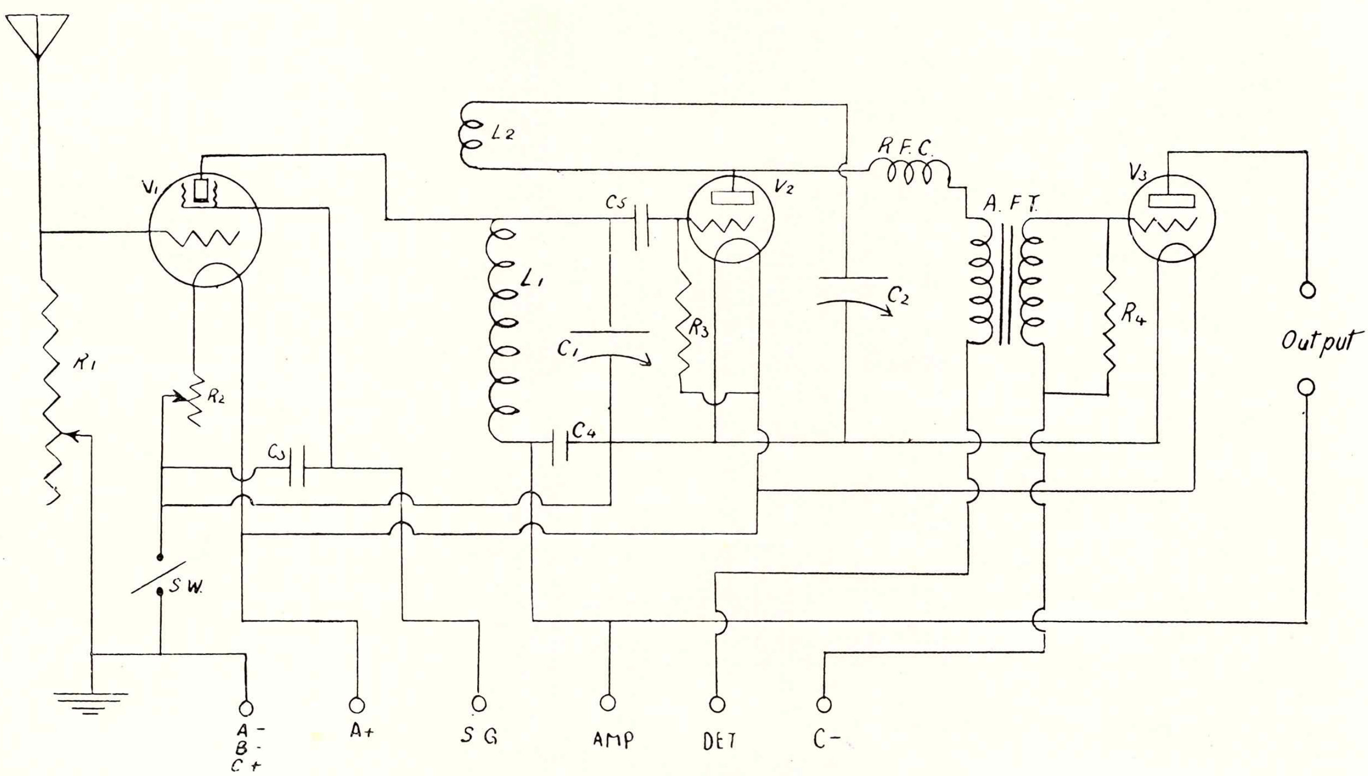


Fig. 1. The Schematic Diagram.

Coil	Turns L_1	Turns L_2	Approximate wavelength in metres.
1	4¾	5	20-35
2	9¾	7	30-60
3	18¾	9	45-90

The above arrangement of set and coils is designed to meet the requirements of the listener to short-wave broadcasts. The amateur whose main object is to listen to Morse transmissions of other hams would need to introduce modifications to give full scale tuning on the various amateur bands, particularly on the 7000 k.c. band where the interference becomes serious with the ordinary receiving set.

ASSEMBLY AND OPERATION

The general lay-out of the set is shown in Fig. 3 and presents no particular difficulty in the assembly and wiring of the various components.

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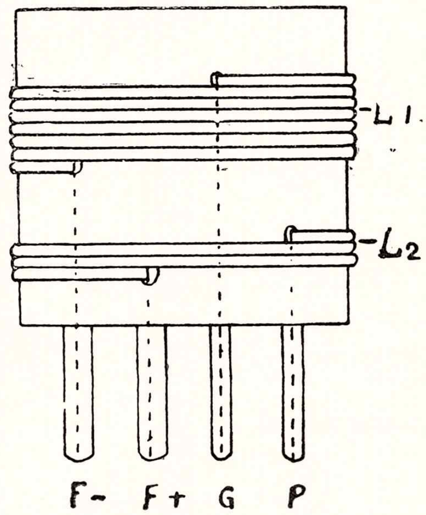
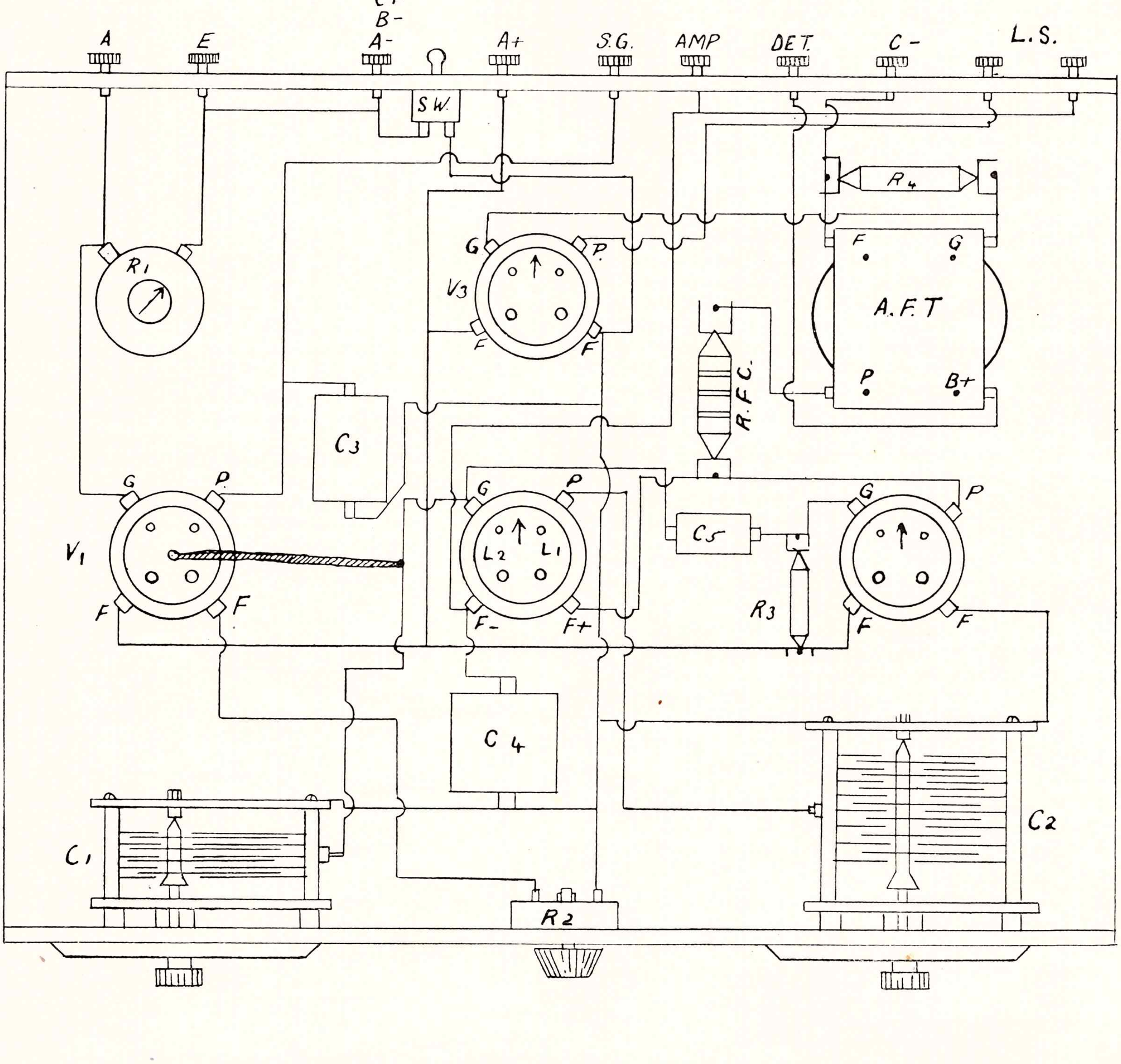




Short Waves for Broadcast Listeners

ADAPTING THE BROADCAST RECEIVER

ALTHOUGH short-wave broadcasts heard at a distance suffer some distortion of music and speech, they are always interesting to listen to particularly in view of the fact that in New Zealand transmissions from many distant countries are easily audible. An adapter unit which can be used with the audio amplifying portion of the ordinary broadcast receiver therefore becomes a useful accessory.

There are various ways of adapting the broadcast receiver for this purpose. For example a separate unit may be built to function on the superheterodyne principle, a somewhat complicated, but entirely satisfactory method. Alternatively, the separate unit may be a special detector of short waves the output of which is connected to the audio amplifier of the receiving set by means of a plug fitting into the detector valve socket of the ordinary receiver. This detector is sometimes preceded by a stage of screen-grid radio-frequency amplification. The use of the screen-grid valve gives very little amplification even in the most carefully constructed adapters, but confers some benefit in (a) preventing interfering radiation from the oscillating detector and (b) eliminating "dead spots" where the detector does not oscillate. For the sake of simplicity we shall describe here a straight detector unit only.

THE CIRCUIT

The circuit of the adapter is shown in Fig. 1 for use with a set using D.C. valves, while Fig. 2 gives the connections for broadcast receiver using A.C. valves.

THE TUNING INDUCTANCES

The tuning coils L_1, L_2 may be of the type already described for our three-valve short-wave receiver.

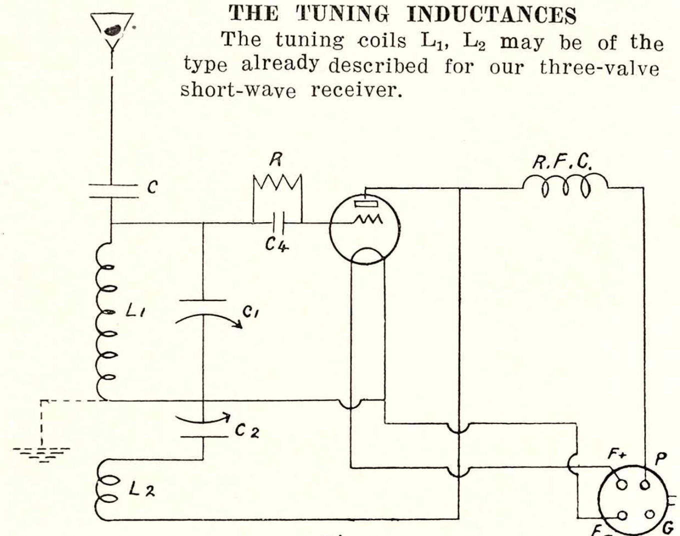


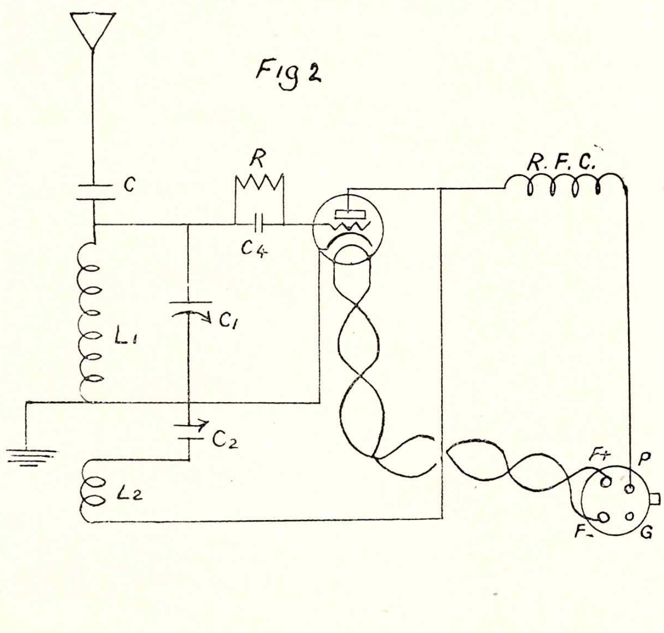
Fig I

THE AERIAL-EARTH CIRCUIT

A single wire aerial, 60-feet long, gives good results on short waves, but a short wire strung across a room or outside will give surprisingly loud signals. The aerial and its lead-in should be kept away as far as possible from surrounding objects.

An earth connection is not always necessary for short-wave work, although it is useful in removing body capacity effects. If the earth connection is to be added care must be taken in the case represented in Fig. 1 to earth the negative filament only if this is earthed in the ordi-

Fig 2



A SHORT WAVE RECEIVER---Continued.

The operation of the set is easy. The appropriate coils for the particular station sought is plugged into its valve socket with the condensers C_1 and C_2 at minimum setting. The resistances R_1, R_2 are set at their maximum readings. The capacity of C_2 is increased slowly until the detector goes into oscillation as evidenced by a very gentle "plop" followed by a faint hissing sound all the time the valve is oscillating. Condenser C_1 should be moved over its full scale setting in order to determine whether oscillation is obtainable over the whole tuning range; failing this it will be necessary to increase the voltage applied to the detector valve plate, or examine the choke to make sure it is correctly built. Failure to get any oscillation at all will mean that connections to the coil L_2 have been incorrectly made. If the set goes in and out of oscillation violently it will be useless for the reception of short-wave broadcasts. In such a case try reducing the detector plate voltage or increasing the value of the grid leak resistance.

Condenser C_1 should again be placed at its minimum then increased very slowly until a carrier wave is heard, the detector being kept oscillating for every position of C_1. By decreasing the capacity of Cf until the detector is just not oscillating the broadcasts should be heard.

When a station is picked up adjustments can be tried for best results with variations R_1, R_2 and the voltage applied to the screening grid of the first valve.

Listeners constructing this set should first read our article on Short-Wave Adapters where many useful hints on obtaining the best in short-wave reception are given.

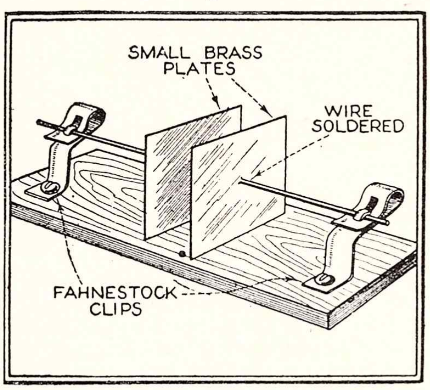
nary receiver so as to prevent possibility of short-circuiting the A-battery.

The aerial is connected to the grid end of the coil L_1 through a small fixed condenser C. This may be a small variable midget of anywhere from 5 to 15 micro-microforads. A suitable condenser may be manufactured easily as shown in Fig. 3 from two brass or copper plates each about ½-inch square. The plates are adjusted to be as close together as possible—without touching, of course—and yet give oscillation of the detector over the full tuning ranges of all the coils. Generally, it will be found satisfactory if the plates are about ⅛-in. apart. If a variable midget condenser is employed, the fixed plates must be connected to the aerial, otherwise body capacity effects will be experienced while the condenser is being adjusted.

THE GRID CIRCUIT

The inductance L_1 is tuned by a good short-wave condenser of capacity .00015 mfd. The plates of the condenser should be rugged and well spaced. The vernier dial used with it should have a smooth mechanism and a high ratio. A noisy dial or one having any backlash whatever will render short-wave reception impossible.

The grid condenser may be .0001 or .00025 mfd. Its value has a decided influence on the smoothness of regeneration which is all-important in the satisfactory reception of short wave broadcasts. If the receiver goes into oscillation with too sudden a "plop" a condenser of the larger value should be used. The grid leak should not be too small or the regeneration will not be sufficiently smooth. Values of 5 to 10 megohms should be tried for best results.



THE REACTION CIRCUIT

The coil L_2 used in conjunction with a variable condenser of capacity .0002 mfd. (midget type) or larger serve to control the amount of regeneration of the detector valve.

The short-wave radio-frequency choke R.F.C. must be of good design if smooth regeneration and oscillation over the whole tuning range are to be obtained. With a poor choke, "dead spots" and other eccentricities of oscillation will obtain.

THE VALVE

The detector valve must be of the same type as that used as detector in the ordinary receiver, in fact it can be the same valve. The socket to hold the valve will need to be of the type to hold the five-pin base if A.C. valves are used. Shock-absorbing sockets should not be used as movement of any metal in a short-wave receiver may cause the station to disappear.

All the wiring should be kept as short as possible and the entire grid lead in particular should be no more than 4 inches long. The grid condenser should be mounted as as near and as rigidly as possible to the detector valve socket.

THE LAYOUT

A possible layout of the D.C. set is shown in Fig. 4. Connection is made between the adapter and the ordinary receiver by three wires soldered to the correct pins (see Fig. 1) of an old valve base. The wires should be flexible and the base should be filled with paraffin wax or beeswax after the wires have been soldered in position.

For use of the adapter the batteries are connected to the ordinary receiver. The aerial is removed and connected to the adapter while the earth wire left on the receiving set will in most cases give proper earthing of the adapter.

The adapter should next be tested for smooth and complete oscillation over the whole tuning ranges and if necessary, adjustment made to setting of condenser C, value of grid condenser and grid leak, and number of turns in the coil L_2.

The general method of tuning is identical with that described for our three-valve short-wave set.

All signals should be tuned in carefully on headphones, and then put on the loud speaker if they are sufficiently strong. Occasionally it is found that signals will vary in strength on touching metal parts of headphones or loudspeaker. This can be eliminated by insertion of small radio-frequency chokes in the output leads.

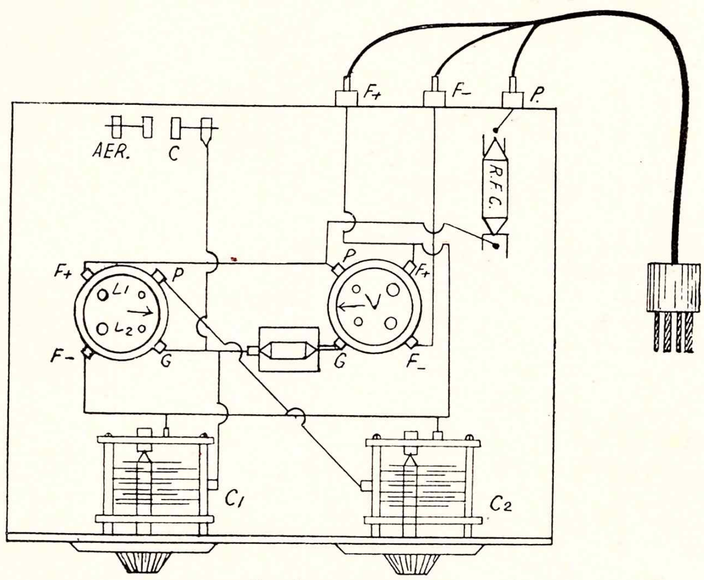


Fig. 4

A metal panel is not necessary, nor is an ebonite or formica panel essential. Three-ply wood is satisfactory.

A good B-eliminator may be used on short-wave receivers. The eliminator must, however, have an efficient filtering system and in such a case the slight residual hum will not prove disturbing with a loud speaker.

A Screen Grid Booster

MODERNISING BROWNING-DRAKE AND OTHER SETS

THOUSANDS of listeners in New Zealand are familiar with the advantages of using a screen grid valve as a radio-frequency amplifier in their receiving set, but at the same time there are many who still pin their faith to the original Browning-Drake receiving set. For the latter, and other users of older type sets, we give details of a simple S.G. booster capable of materially increasing the range of any set. Boosters were introduced when S.G. valves first made their appearance, but for some reason they did not achieve much popularity in spite of the fact that properly constructed they greatly increase the sensitiveness of standard receivers. For example, a three-valve set in use in Auckland by the writer last winter made 2YA's daylight signals scarcely audible on the speaker. Adding the S.G. booster about to be described, the account of the final British—All-Black Test Match was heard easily by a roomfull of people.

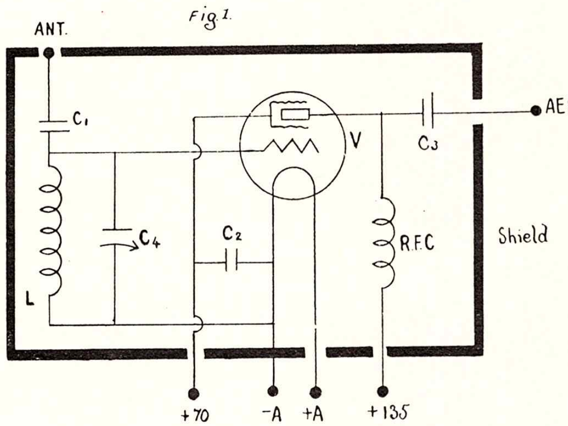


Fig. 1. The circuit diagram.

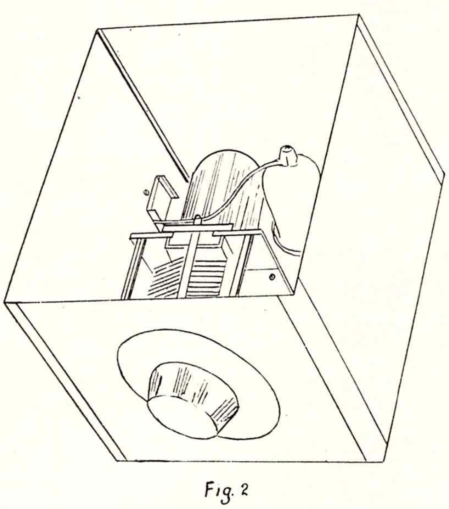


Fig. 2. The Booster with cover removed.

A BATTERY OPERATED BOOSTER

The circuit diagram of a satisfactory D.C. booster unit is shown in Fig. 1 and is the arrangement of the commercial type shown in Fig. 2. It is assumed that a British or Dutch type of S.G. valve is to be used, but where the American valve is preferred, connection will have to be modified slightly in the manner explained in the manufacturer's pamphlet.

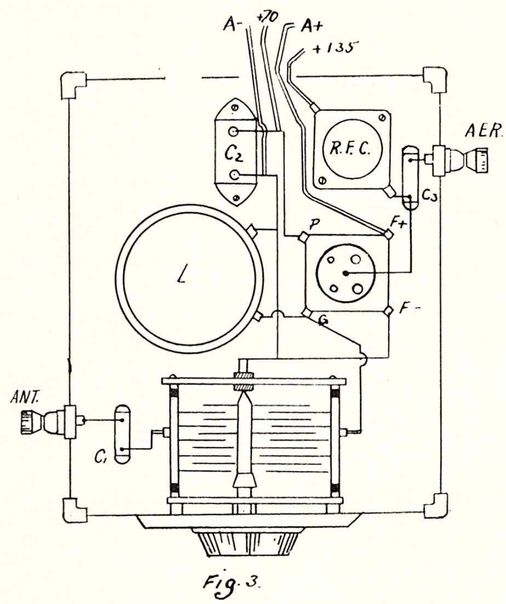


Fig. 3. The layout diagram

The various components are:—

L = tuning inductance consisting of 60 turns of No. 24 D.S.C. wire on a 2½in. former.
R.F.C. = radio frequency choke for broadcast band.
C_1 = fixed condenser of .0001 mfd. capacity.
C_2 = by-pass condenser of .1 to .5 mfd.
C_3 = fixed condenser .0001 to .00025 mfd.
C_5 = variable condenser of capacity .0005 mfd.

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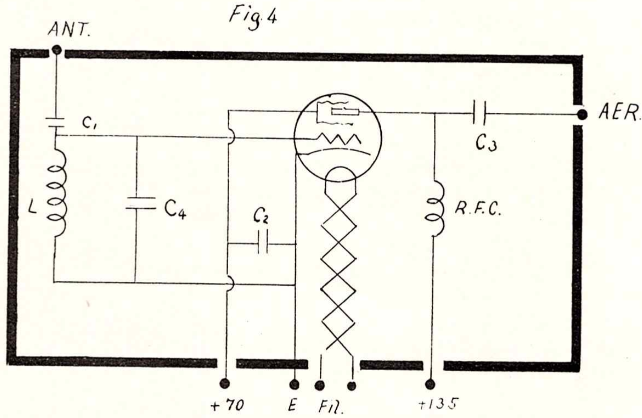

Fig. 4. An A.C. Booster Unit

A Band Pass Tuner and One Valve Battery Set

HOW TO OBTAIN SELECTIVITY AND QUALITY

THE object of the constructional articles in the N.Z. Radio series of handbooks is to present to our readers such of the latest developments in the design of receiving apparatus as may be built by the average amateur constructor. The 1930 Handbook Annual discussed some more or less general type of receiving sets. This year's publication is intended to feature selective sets using band pass filter units while the indications are that the 1932 issue will deal mainly with superheterodyne receivers.

The trend of modern radio design is still towards increase in selectivity and quality of reproduction. Until recently it was considered that a high degree of selectivity could be obtained only by the use of a number of stages of tuned radio-frequency amplification. Selectivity is obtained in this way, however, only at a price. The sidebands are cut, with the result that high notes are not reproduced so that the music from the loud speaker has a characteristic deep tone devoid of all "crispness."

Selectivity without sacrifice of quality may be obtained from a well-designed band pass unit. This will be found effective even with a straight detector where no radio-frequency amplification is used. The circuit diagram of such a unit is shown in Fig. 1 connected to the conventional leaky-grid detector valve as indicated by the dotted lines.

THE COMPONENTS

The variable condensers required for the construction of the units are:—

C_1, C_2—Ganged condensers each .0005 mfd.
Cm—Coupling condenser, .01mfd.
C_3—Trimming condenser about 1.5 to 50 mmfd.
C_4—Reaction condenser, .00025 mfd.

THE INDUCTANCES

The coils L_1 and L_2 need to be constructed carefully. They must be matched as nearly as possible and should not be of too "low-loss design. They may be wound on

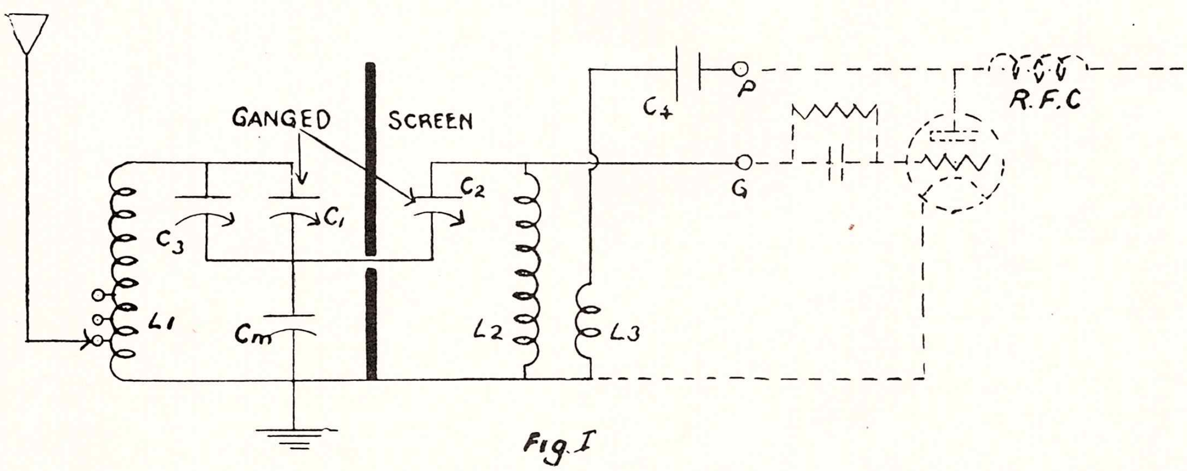

Fig. 1. Circuit diagram of a Band-pass Unit.

A SCREEN GRID BOOSTER---Continued.

The terminal ANT is connected to the aerial while the terminal AER is connected to the ordinary aerial terminal of the receiving set.

The battery voltages applied to the screen grid and the plate of the valve are shown to be 70 and 135 respectively. These are not fixed values; for example, they could be 45 and 90 respectively, but the higher the voltage applied to the plate, within the limit set by the valve manufacturer, the better. The S.G. voltage should be about one-half that applied to the plate.

The whole unit must be completely shilded by being built into a suitable aluminium or copper box.

THE LAY-OUT OF THE UNIT

The tuning coil may be mounted on the fixed condenser by metal brackets or on the baseboard as shown in Fig. 3. It will be noticed that A— is connected to the metal shield and also to the moving plates of the fixed condenser on the assumption the A— is earthed in the set proper. It this case the variable condenser may be mounted directly on the metal panel and need not be insulated from it. The two terminals ANT and AER must be mounted with insulating bushes.

Connections are shown for the type of S.G. valve which has the plate connection made to the terminal on the top of the valve.

No terminals are provided for battery connections as a four-wire cable may be used.

AN A.C. BOOSTER

The arrangement for a mains-operated booster is shown in Fig. 4. The cathode is earthed and also connected to the grid return lead. A five-pin valve socket will be required.

ribbed ebonite former of diameter 2¼in. overall. They are wound with No. 26 D.C.C. wire, turns touching, each coil having 80 turns so that pieces of former 3½in. long will be suitable. The coil L_1 has tappings on it for the aerial and these may be made at 14, 18, 24, 34 turns, the aerial being connected to the tapping which gives the best compromise between signal strength and smoothness of reaction control.

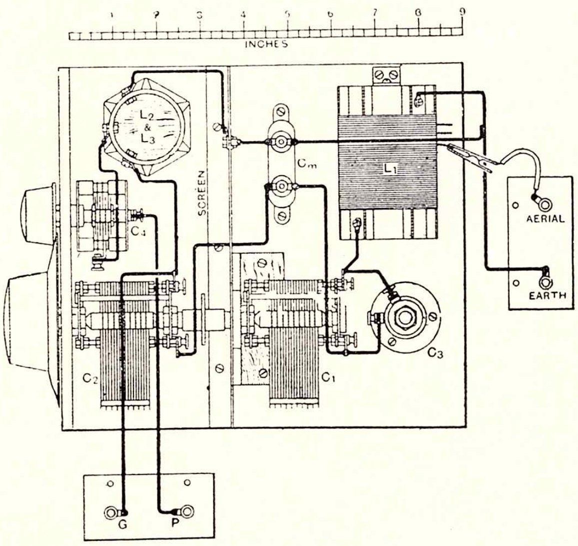

Fig. 2. The lay-out diagram.

The reaction winding, L_3, must be put at the filament end of L_2 and consists of 15 turns of No 34 D.S.C. wire. Fine wire is necessary for this winding in order to reduce the capacity effect between the two windings.

The components may be mounted as shown in Fig. 2. The two coils are mounted on a wooden baseboard with their axes at right angles and are separated by a vertical aluminium screen. The condenser C_2 is shown mounted

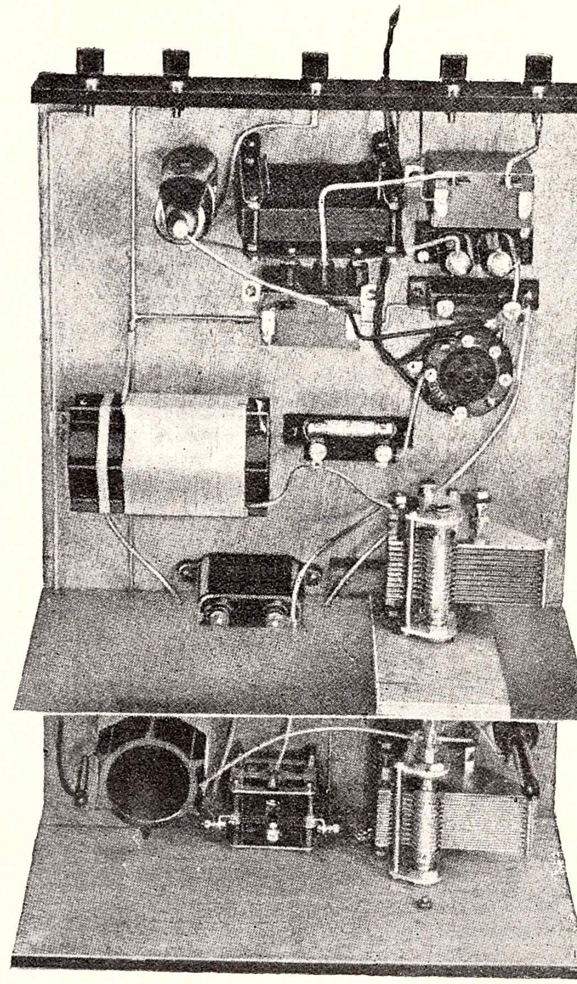

Fig. 4. The One-valve Set

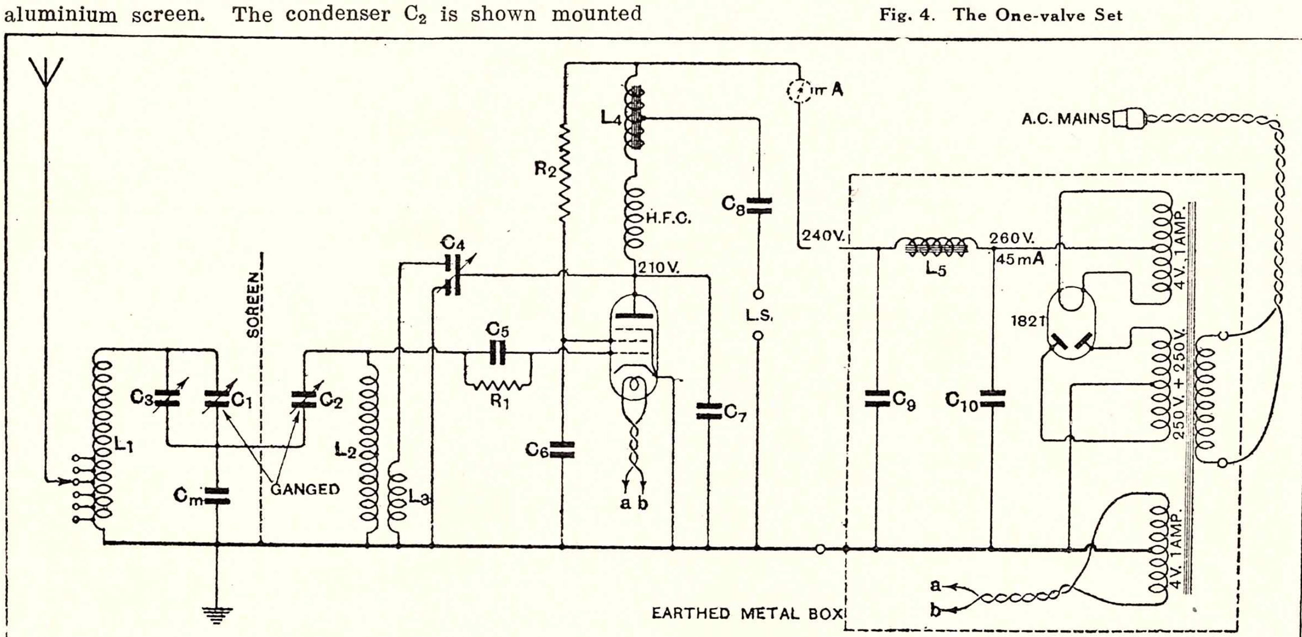

Fig. 3—The circuit diagram of a one valve set. C_1 and C_2, ganged 0.0005 mfd. log. law variable condensers; C_3, trimming condenser 1.5 to 50 uuF; C_4, 0.0002 mfd. differential condenser; C_5, 0.0001 mfd.; C_6 and C_8, 2 mfd. 700 volt D.C. test; C_7, 0.001 mfd.; C_9 and C_{10}, 4 mfd. 700 volt D.C. test; Cm, 0.01 mfd. R_1, 0.5 meg. R_2, 15,000 ohms; L_4, centre-tapped L.F. choke, 35 henrys inductance with 40 mA. D.C. resistance 410 ohms; L_5 L.F. choke, 22 henrys inductance at 45mA.; D.C. resistance 430 ohms. The mains transformer has 3 centre-tapped secondary windings; 4 volt, 1.0 amp.; 4 volt, 1.0 amp.; 250 volt + 250 volt. Details of the coils L_1, L_2 and L_3 are given in the text.

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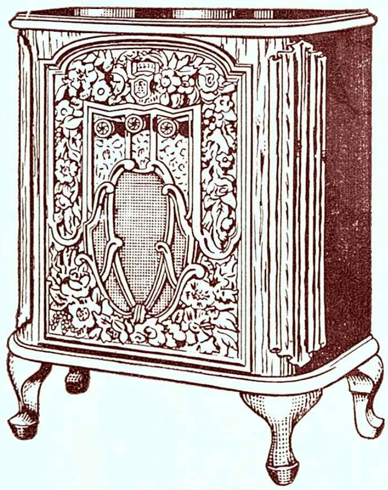

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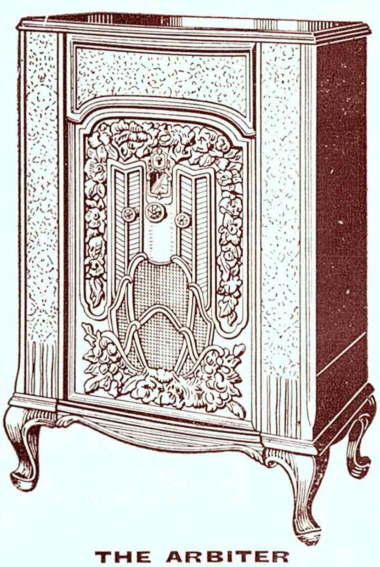

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on a piece of wood alongside the screen and it is important to notice it must have no metallic contact with the screen. The trimmer condenser C_3 is depicted as a neutralising condenser. If the screening and placement of the coils has been carried out effectively no signals should be heard when the coupling condenser Cm is short-circuited. The exact value of the coupling condenser depends upon the constants of the coils and the wavelength of the station it is wished to keep to a narrow tuning range. The value of .01 mfd. suggested is a good average value, but Wellington listeners would probably find that a high value of capacity, say .015, would be preferable if 2FC is to be heard when 2YA is on the air. When ganging the two variable condensers C_1 and C_2, first adjust the trimmer condenser C_3 to a minimum, loosen the screws on one side of the universal joint, bring the two sets of moving plates approximately into line, and tune in a station of low wavelength, using the trimmer to obtain miximum signal strength. Finally tune again to the lower wavelength and regang without altering the setting of the trimmer. It will then be found that the ganging holds over the complete waveband.

A ONE-VALVE LOUD SPEAKER SET

This band pass unit has been used by the English magazine, The Wireless World, for the construction of a one-valve set for which is claimed that loud-speaker reproduction is obtainable from the local station. The valve used is one of the new A.C. pentodes, not obtainable in New Zealand at the time of writing so that it has been impossible to try the arrangement under local conditions. The circuit is shown in Fig. 3 and would be worth experimenting with when the valves are available.

The coils are wound as for the tuner unit described above.

It will be noticed that a differential reaction condenser has been used and that the whole set is designed for complete operation from the mains. The voltage required from the secondary windings are clearly shown. The rectifier is the inexpensive Philips 1821. The whole rectifier unit is mounted in an earthed metal container as shown in the photograph in Fig. 4.

The operation is the same as described above.

MAKING A SCRAPER

THE blade of a knife never seems to be able to get right into the corner between the threaded stalk and the flat part of the terminal; the scraper, however, does the job easily and quickly. Anyone who possesses an emery wheel can make up a first-rate scraper for himself from an old half-round file about five or six inches in length.

Begin by grinding both the flat and the round surfaces of the file smooth for about an inch from the end. Then grind this part to a width of a quarter of an inch, and afterwards point it off rather sharply. The edge between the flat and the round faces must be straight and quite sharp.

Grinding is made easier if the file is first "let down" by bringing it to white heat and allowing it to cool slowly. It can be retempered subsequently by heating it up again and immersing it gradually in water or oil. Since you will never have to cut any very hard metal in wireless work, no very fine tempering is required.

Small files, if they are used just as they are purchased, have a very nasty knack of making the palm of their owner's hands pretty sore with their sharp tangs.

Ideally, one should fit every file with a handle of its own, but not everyone wants to go to the trouble and expense of doing this. A further point is that handles take up a good deal of space. One can keep quite a number of handleless small files in an old cigarette tin of the hundred size but if they are provided with handles somthing a good deal bigger is needed.

A tip which saves both space and money is to provide a single handle, into which any of the files can be fitted. These hanndles, which are quite cheap, consist of a wooden grip with a rather long metal ferrule furnished with a set-screw. The tang of the file is pushed into the ferrule and a turn of the set-screw makes it as tight as is necessary. The cigarette tin still remains big enough to house the equipment of files and the one handle which serves for all of them

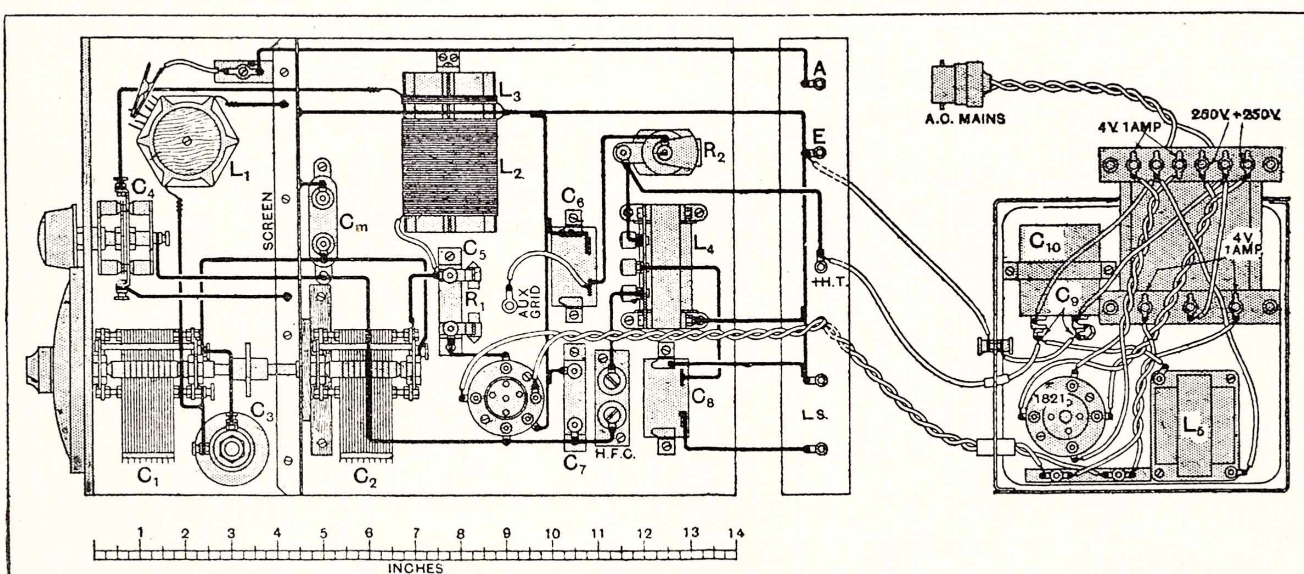


Fig. 5. Complete Layout of One-valve Band Pass Set

A Band Pass Three. General Purpose Receiver.

Fig. I

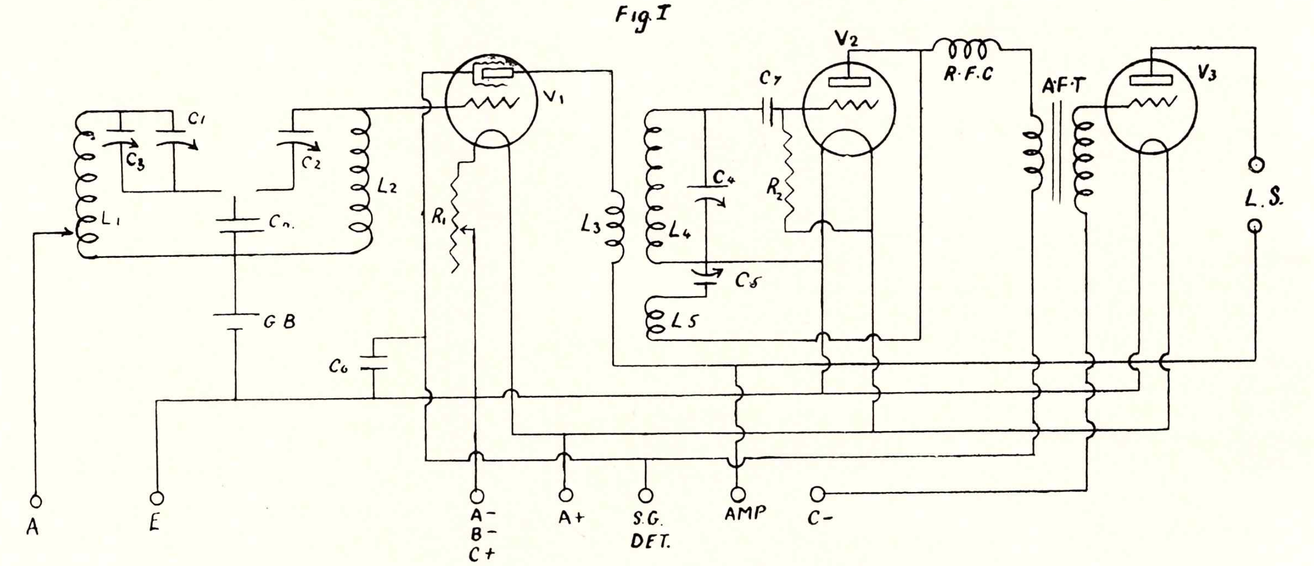


Fig. 1 Schematic Diagram of a D.C. Band Pass Three

FOR the first time in New Zealand we present constructional details of a band pass receiving set which will be found to give excellent results for general work. The design of the tuning portion follows closely that given in the preceding article which should be read through carefully.

The schematic diagram of the set for use with ordinary valves is shown in Fig. 1, the values of the various components being as follows:—

L_1, L_2, L_3, L_4, L_5—Tuning coils as described below.
C_1, C_2, C_4—Variable condensers, capacity .00035 mfd.
C_3—Trimmer condenser of neutralising type.
C_5—Variable reaction condenser, .0002 mfd., midget type.
Cm—Coupling condenser, .01 mfd.
C_6—By-pass condenser .25 mfd.
C_7—Grid condenser, .00025 mfd.
R_1—30-ohm rheostat.
R_2—Grid leak, 2 megohms.
R.F.C.—Radio-frequency choke to suit broadcast band.
A.F.T.—Audio-frequency transformer, 3 to 1 ratio.
G.B.—Grid bias call, 1.5 volts.

For an A.C. set with complete mains operation, the arrangement shown in Fig. 2 will be adopted. The values of the additional components required are:—
R_3—Variable wire-wound resistance, 600 ohms.
C_8—Fixed condenser, 1 mfd.
R_4—50-ohms, centre-tapped resistance.
R_5—Bias resistor, see below.
C_9—Fixed condenser, 1 mfd.

THE VALVES

The valve V_1 is a screen-grid valve and must be of the indirectly heated type for the A.C. set. V_2 is the detector and V_3 a semi-power valve.

The correct B voltages are determined by the type of valve which is to be used and they may be supplied from eliminator in either of the two sets. When building the eliminator care must be taken to provide the correct outputs as described elsewhere in our articles on power packs and valve amplifiers.

In the set of Fig. 1 the valve filaments will be heated by a battery while the A.C. set will use low voltage A.C. from the power pack connected to a,b.

Fig 2

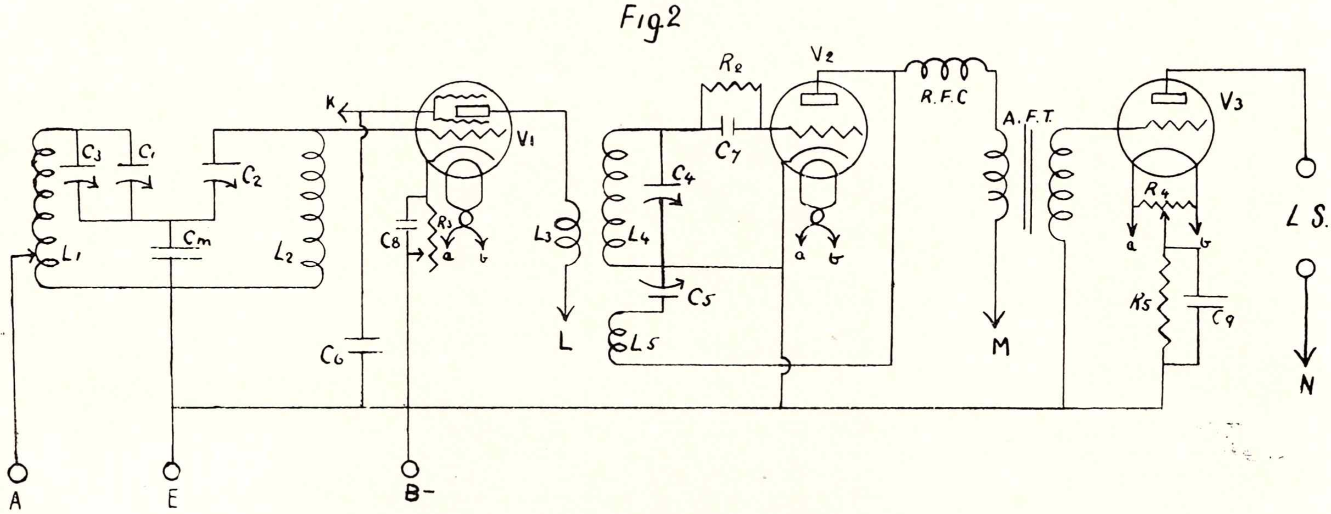


Fig. 2 Schematic Diagram of the A.C. Band Pass Three. For valves and components, see text.

The size of the bias resistor R_5 can be determined by the constructor in the manner described for our low power valve amplifier.

THE INDUCTANCES

The coils L_1, L_2 each have 68 turns of No. 24 D.S.C. wire wound on a former 2½in. diameter. On L_1 a tapping is made at the 18th turn from the beginning of the winding the aerial subsequently being connected to the tapping. The two coils have attached small brass angle brackets so that they may be mounted vertically in the set.

The beginning and end of the windings should be brought to soldering lugs at the bottom of the coil in convenient positions for the final wiring.

For the coils L_3, L_4, L_5 another former of 2½in. diameter is required. There is wound on first of all 20 turns of No. 38 D.S.C. wire for the reaction coil L5. The beginning and ends of this winding corresponds to y and z respectively in Fig. 3. One-quarter inch from this winding there are put on 68 turns of No. 24 D.S.C. wire, the beginning and ends of this winding L_4 being w and x respectively in Fig. 3.

Tha primary winding L_3 consists of 30 turns of No. 28 D.C.C. wire jumble wound in a slot as in the Browning Drake set (See Handbook Annual, 1930, page 35).

THE LAYOUT OF THE SET

The layout diagram of the A.C. set is shown in Fig. 3. Two screening boxes and a vertical metal shield are required and it is important to note that the plates of the condensers C_1, C_2 must be insulated from the metal boxes.

The power is shown as being supplied from a cable connected to the power pack which could, if desired, be built into the set itself instead of being a separate unit. The wires of the cable are lettered to correspond with the schematic diagram.

The ganging of the two condensers C_1, C_2 is carried out in the manner described in the preceding article while the general method of operation follows that of the other sets in this book having similar reaction control.

Fig. 3.

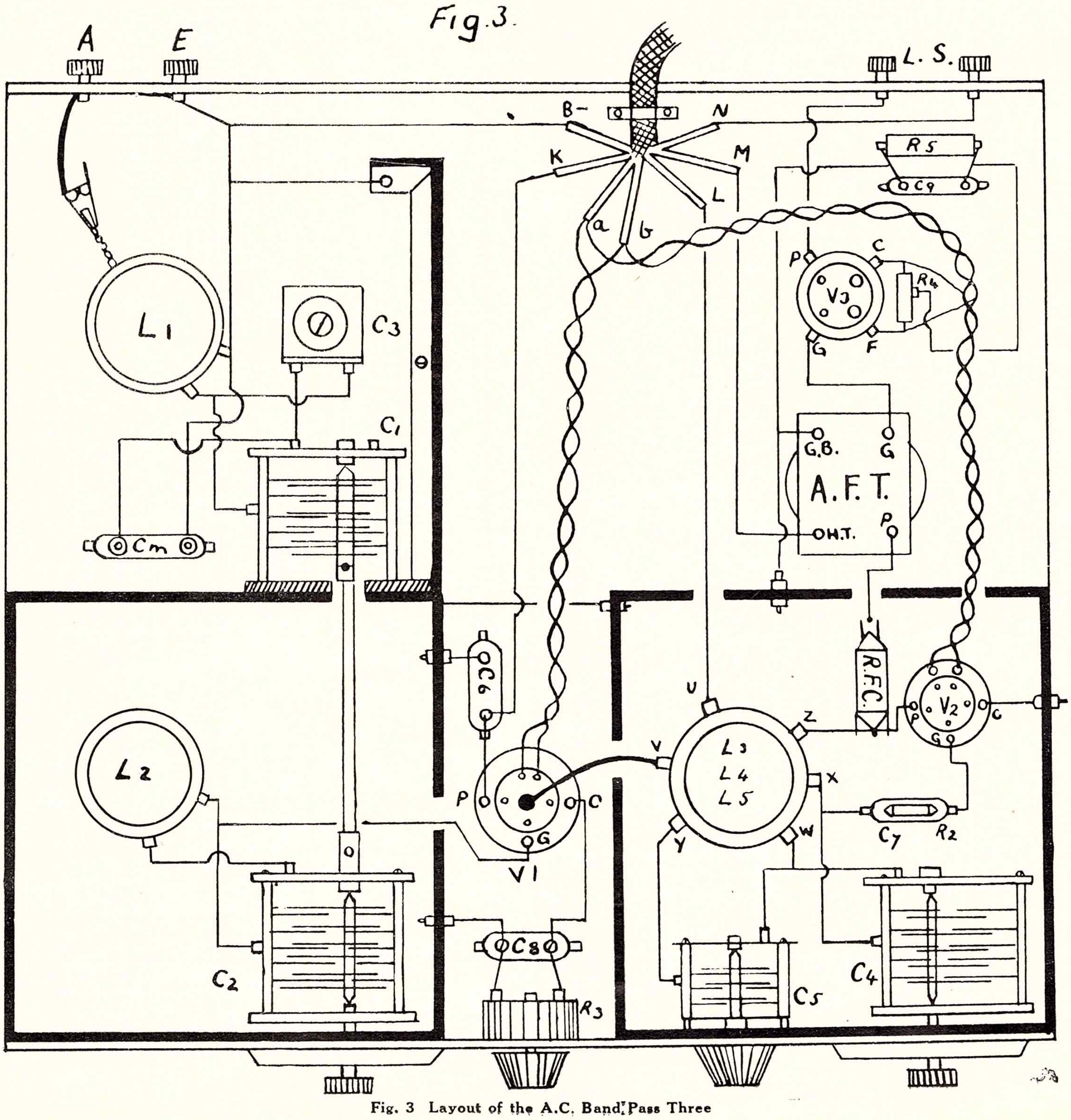


Fig. 3 Layout of the A.C. Band Pass Three

BATTERY CHARGING

Charging Batteries from D.C. Mains

ACCUMULATOR A- and B-batteries may be charged very easily where the house electric supply is D.C., although in the case of the A-battery the process is not a very economical one.

The first step necessary is to ascertain which is the positive and which the negative lead of the mains and for this purpose two well-insulated wires with the ends bared are attached to the wall plug. If the plug is not of the polarised type it will be necessary to mark the plug and socket so that connection may be made in the same way in the future. The free ends of the wire are inserted in some tap water in a cup about an inch apart and are held carefully so that there is no danger of their touching. It will be noted that bubbles of gas are given off from one wire—the negative. The positive and negative wires when thus located are carefully marked in some way.

CHARGING B-BATTERIES

To charge B-batteries the mains are connected through a lamp as in Fig. 1 in such a way that the positive main is connected to the positive of the B-battery. The current is switched on and the batteries are left charging until they have been gassing freely for two or three hours. A 60-watt lamp will do very well.

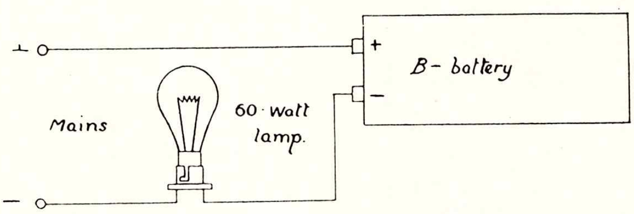


Fig. 1. A D.C. battery charger for B accumulators.

CHARGING A-BATTERIES

Where a slow rate of charge is required for the A-accumulator a similar arrangement to that shown in Fig. 1 will suffice, the accumulator being connected in place of the B-battery. If it is desired to charge both accumulators at the same time the 6-volt accumulator may be connected between the B-battery negative and the lamp, care being taken to connect the negative of the B-battery to the positive of the 6-volt accumulator. The current through the 6-volt accumulator where one lamp is used will be about ¼-ampere.

Where higher rates of charge are needed a higher power lamp, or alternatively two 60-watt lamps connected in parallel as shown in Fig. 2, must be used. In this case the charging current will be about ½-amp. For still higher charging rates the lamps may be replaced by a 500-watt radiator element when the charging current

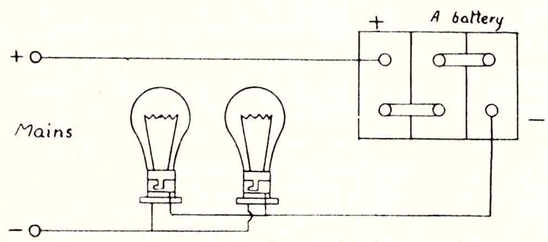


Fig. 2. A D.C. battery charger for A accumulators.

will be about 2 amps. In the last case care will have to be exercised in order to see that there is ample ventilation for the heat generated in the radiator element to be conducted away.

The cost of charging A batteries in this way is comparatively high; for example, with the 500-watt resistor element referred to above, it would cost the price of a unit for two hour's charging. This may, of course, work out cheaper than the usual cost of charging at a service station, and in any case saves the trouble of carrying the battery about.

Charging Batteries from A.C. Mains

BOTH A and B accumulator batteries may be charged from A. C. mains in an economical manner and although the apparatus required is more complicated than for the corresponding D.C. case it may be assembled cheaply by a careful amateur constructor.

AN A-BATTERY CHARGER

To charge the A-battery from A.C. mains it is first necessary to step-down the voltage from 230 to a suitable value by means of a transformer and then to rectify the output before applying it to the accumulator. Half-wave rectification is sufficient for the purpose and the cheapest type of rectifier is the copper-copper oxide type, usually called the metal rectifier.

Many ranges of metal rectifier are available, but the most useful—and the cheapest—will probably be the type A3 which gives a charging rate of 1 ampere. This rectifier requires an input of about 13 volts and the

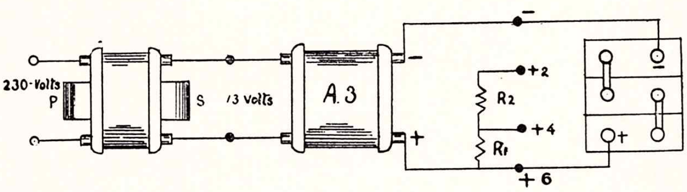


Fig. 1. Charging a low-voltage accumulator from A.C. mains

transformer used must step-down the mains voltage to 13. The power output of the transformer will be 13 watts and reference to the table in the article on transformers will give the necessary details for its construction.

The transformer is connected to the rectifier as shown in Fig. 1 and if 4-volt or 2-volt accumulator is to be charged connection should be made to the appropriate terminal. Resistances are essential for the lower voltages in order to prevent an overload of the rectifier unit. R_1 should be 4 ohms and R_2 3 ohms.

B-BATTERY CHARGERS

Methods of charging B-batteries are shown in Fig. 2. With both types of rectifier the charging rate should not exceed about 30 milliamps. and to keep the current at this value a rheostat is essential and a milliameter desirable.

In the case shown in Fig. 2b where the H.T.4 rectifier is used, the transformer may be dispensed with provided that the B-battery is disconnected from the receiving set while it is being charged.

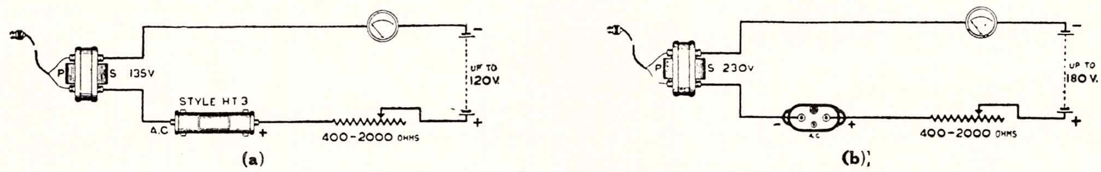
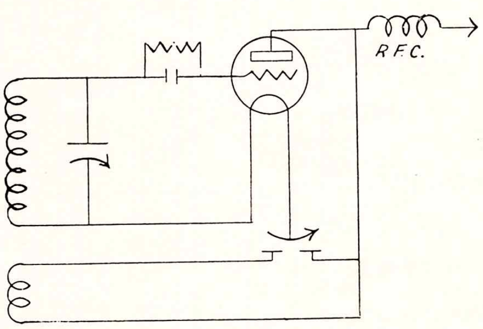


Fig. 2. Charging accumulator B-batteries from A.C. mains

The Differential Condenser

SMOOTH REACTION CONTROL

MANY enquiries have been received by "New Zealand Radio" concerning the use of a differential condenser for the control of regeneration in the detector valve—a method introduced recently in England. The condenser consists essentially of a set of moving plates which rotate between two sets of fixed plates which are insulated from each other, and it is stated that in this way it is possible to obtain a much smoother reaction control than with the ordinary variable condenser.



The method of connecting the differential condenser is shown in the accompanying diagram of detector valve tuning circuits. The moving plates are connected to filament negative and the two sets of fixed plates in the manner indicated.

Aluminium Panels

AN aluminium panel looks attractive and it can have definite technical advantages. Attempts are made in the majority of modern circuits to get one side of each of the variable condensers at each potential, that is, in direct metallic connection with the earth terminal of the set.

When this is done there is no reason at all why the variable condensers should not be mounted on a metal panel. The use of this reduces the number of leads required and also makes for greater stability of control and freedom from capacity effects. But aluminium is a very difficult material to work, and, if possible, a drilled panel should be obtained.

It will be found that the small drills you generally employ for working ebonite are not quite hard enough for aluminium, and in any case drills that have been used for ebonite are generally pretty blunt. A quick, though not particularly professional, manner of boring holes in aluminium is as follows:—

A hole is first of all pierced with a sharp bradawl or the point of one blade of an old pair of scissors. The hole is then reamed out with the tang of a file or with a reamer to the required dimensions, and finally trimmed neatly with a file. The boring should be carried out from the front of the panel, as the trimming up with the file will tend to cause scratches. It is useful to bear this procedure in mind when dealing with the soft copper screening which sometimes figures in a modern set. It is not the way an engineer would tackle the problem, but the amateur hampered by lack of proper tools is frequently forced to take such measures.

An A.C. Screen Grid Four

A STABLE SINGLE CONTROL SET CAPABLE OF GIVING REMARKABLE RESULTS

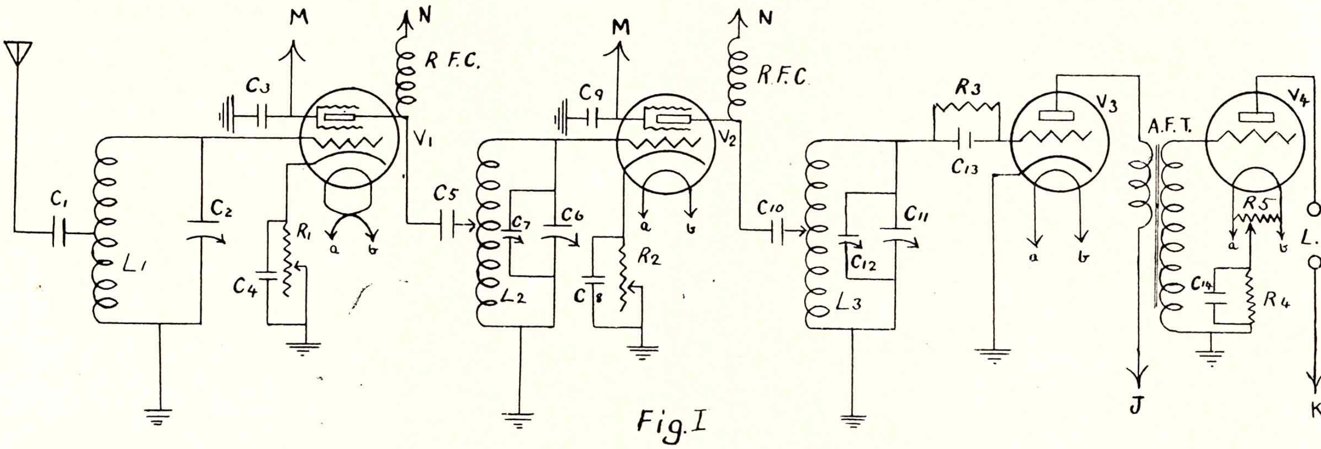


Fig. 1 Schematic Diagram of 4 valve A.C. set.

IN response to many requests we are giving this year a description of an all mains rceiving set with two stages of screen grid amplification and a single tuning control. The information and diagrams have been made as clear as possible, but let it be said that a set of the nature of the one about to be described should be constructed only by amateurs who by experience have mastered the tricks of operation of S.G. radio frequency amplifiers.

THE CIRCUIT

The circuit diagram is shown in Fig. 1 and it will be seen that the radio frequency stages are coupled through fixed condensers of capacity .0001 mfd. to a suitable point on the grid tuning coils. The S.G. valve voltages are applied through radio-frequency chokes, R.F.C., which should be of a type designed for operation on the ordinary broadcast band.

Tuning is carried out by three ganged condensers, two of them having associated trimmer condensers, small neutralising variables.

The resistance R_1 in the cathode circuit of the first valve is mounted on the main panel and serves as a volume control. A similar resistance R_2 is used to bias the second valve and is adjusted to the best value and then left untouched.

The valve filaments are heated by unrectified A.C. obtained from the transformer incorporated in a suitable power pack, designed according to methods given elsewhere to suit the valves to be used. Plate voltages are obtained also from the power pack which may, if desired, be incorporated in the final set itself. We have made no attempt to specify valve voltages owing to the diverse types which will be used by the constructor, but a study of our account of power pack design should give all the required information.

Common connections to earth are indicated while connections to J, K, M, N, supply the plate voltages.

The method of calculating tha value of the bias resistor R_4 is described in the article on a Low Power Amplifier.

THE VALVES

V_1, V_2, are screen-grid valves, V_3 is the detector and V_4 a power valve. They are all indirectly heated axcept V_4, which also may be of the same type if desired. The power valve must be able to handle a large output without sign of distortion. Such a valve will pass a fairly large plate current so that the loud speaker should be connected to the terminals L.S. through an output transformer or its windings will be damaged.

THE TUNING COILS

Each coil may consist of 50 turns of No. 24 D.S.C. wire on a former 2½in. in diameter, preferably of ribbed abonite. The lower or beginning end of each coil is connected to earth while the finishing end goes to the fixed plates of the corresponding tuning condenser. The formers should be arranged for vertical mounting. The tapping may in each case be half way up the coil. When tappings are made near the tops of the coils, greater signal strength, but poor selectivity will be the result. The lower down the coil the tapping, i.e., the nearer the starting end, the greater the selectivity, but the halfway tapping suggested will probably be best for all round use. The three coils should be made as nearly alike as possible.

THE COMPONENTS

The parts raquired for the set are :—

V_1, V_2, V_3, V_4—Valves as above
One 4-pin valve socket.
One 4-pin valve socket.
Three screening boxes.
C_1, C_5, C_{10}—Fixed condensers each .0001 mfd., mica type.
C_2, C_6, C_{11}—Variable condensers each .0005 mfd, with drum dial and connecting shafting.
C_3, C_4, C_8, C_9, C_{14}—Fixed condensers, 1 mfd., 500-volt test.
C_7, C_{12}—Trimmer condensers as above.
C_{13}—Grid condenser .00025 mfd.
L_1, L_2, L_3—Tuning coils as described in text.
R.F.C.—Radio-frequency chokes (two).
R_1, R_2,—Variable wire-wound resistances, 1,000 ohms.
R_3—Grid leak, 2 megohms.
R_4—Bias resistor, see text.
R_5—50-ohm centre tapped desistance.
A.F.T.—Audio frequency transformer, 3 to 1 ratio.
Power pack, panel, baseboard, etc.

THE LAYOUT

A possible layout of the set is shown in Fig. 2, The condensers are coupled by suitable ¼-inch brass rods and are rotated by a drum dial operated by the knob T. The trimmer condensers are for convenience mounted on the back face of the screening boxes as shown. In this position they are readily accessible for adjusting. The moving plates of all the condensers are earthed. The ganged condenser must be aligned carefully for free movement.

The volume control R_1 is mounted on the main panel.

The valve V_1 is placed betwene screening boxes and this gives sufficent screening of the valve itself.

The filament wires should be twisted and flexible covered wire of heavy gauge. The plate voltage wires are connected to the power pack.

For correct ganging the power is switched off, the grub screws to the condenser coupling shaft are loosened and all three tuning condensers set at the zero position. The grub screws are then tightened and the lids put on the screening boxes. With all the moving plates exactly in step tune in a loud distant station when the trimmer condensers are about three parts "in." Adjust R_1, R_2, for loudest signals and leaving the main tuning alone obtain the sharpest tuning setting by means of each of the trimmers. This adjustment is best made on a wavelength of 300 to 400 metres. Should a stage not be in tune when a trimming condenser has reached its limit of adjustment, shift the main tuning, with power off, and bring with the trimmers back by a corresponding amount.

Other stations are now tuned in by use of the main tuning control alone, the volume being regulated by means of R_1.

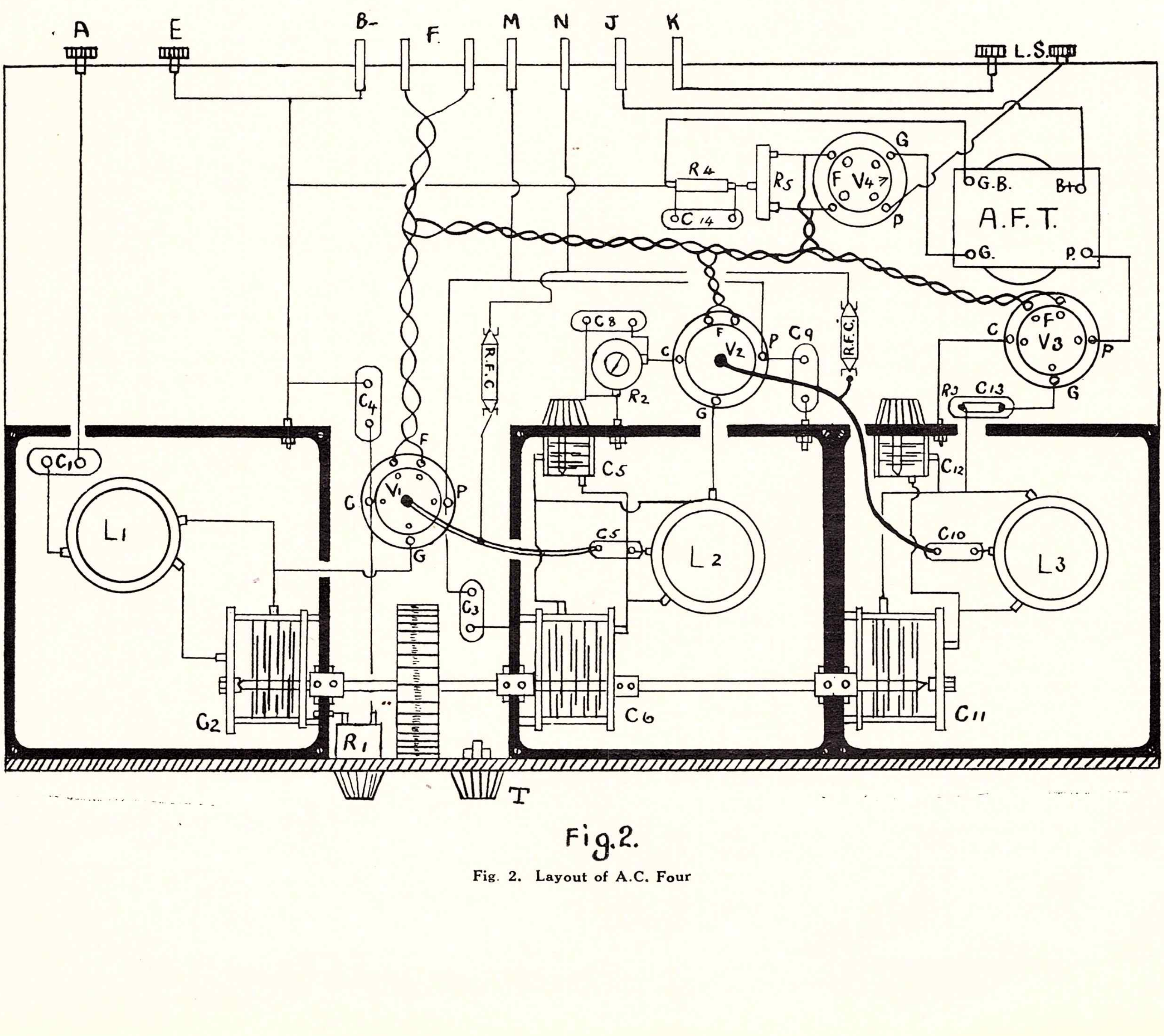


Fig. 2. Layout of A.C. Four

A D.C. ELIMINATOR

A Hum Proof High Tension Unit

PLATE and filament valve voltages may be obtained readily and economically from A.C. mains with apparatus which, when properly designed, is as safe to handle as electric irons, radiators, or any other piece of household electrical equipment. With D.C. supply, however, very special precautions must be taken if the mains are to provide the power for a receiving set.

A D.C. supply can be adapted to supply both filament and plate voltages to the valves of receiving sets, but in our opinion it is better to use an accumulator for the low voltage and the mains for high tension only. The unit to be described here is a B-battery eliminator.

The apparatus will be found to be similar in many respects to the A.C. eliminator described elsewhere. For example, there is a filter system and voltage dropping resistances by-passed by fixed condensers, but there is no transformer.

THREE-WIRE DISTRIBUTION

In order to appreciate fully the other points of difference it is necessary to understand the method of distribution of D.C., as usually effected by the three-wire system, shown in Fig. 1. The central "neutral" wire is earthed at the generating station, and consumers will obtain their 230-volt supply by being connected to either A and B or C and D. In one case the negative lead A would have a potential of about 230 volts below earth, while in the other case the positive lead D would be about 230 volts above earth. Leads taken from the points A and D would give 460 volts.

The neutral wire is earthed, but since it has a small resistance, R, the large current passing through it will cause B and C to have a small voltage above the true earth point E.

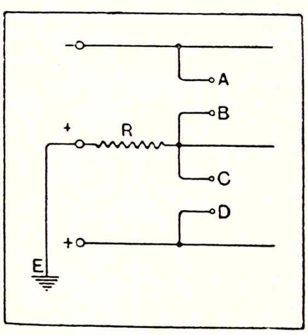


Fig. 1. The three-wire supply system. The consumer will either be connected to A and B or C and D. Owing to the small resistance R, the neutral lead at the consumer's end may have a difference of potential to earth.

One method of determining which is the positive and which is the negative wire is to connect two well-insulated wires with their ends bared to the mains, and dip them in tap water about an inch apart. The one at which bubbles of gas are evolved freely is the negative.

AN EARTH CONDENSER NECESSARY

If we connected to A and B, the usual earthing of the negative filament in a receiver connected to the mains will mean a complete short-circuit of the supply. If we happen to be connected to C and D, our negative filament will entail a flow of current from the neutral conductor to earth, a forbidden practice. It is thus clear that an earth condenser (see C_9, Fig. 5) must be included in a D.C. eliminator. With the three-wire system it is possible for a momentary fault to arise at the generating station whereby the plates of the earth condenser have a voltage difference of twice that of the supply mains; the test voltage for this component should therefore not be less than 500.

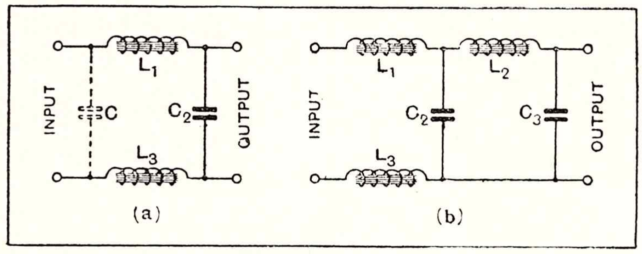


Fig. 2—(a) A simple filter for D.C. mains. The choke L_3 can often be dispensed with when dealing with a negative neutral. Owing to the capacity of the mains a condenser C (in dotted lines) in the position shown would be useless. (b) A more ambitious double filter necessary when the mains are "rough" and especially useful where mercury arc rectification is used.

THE FILTER SYSTEM

With a positive neutral conductor (A and B, Fig. 1) there is always a flow of ripple current through the negative lead, and it is for this reason that a choke of high impedance to fluctuating currents and a low resistance to D.C. must be interposed. The omission of this choke will cause serious hum. It may be found, however, that with a supply having a negative neutral, L3 is not necessary.

In Fig. 2 (a) the simplest D.C. filter is shown; if the mains happen to be reasonably smooth the output after it has passed through the necessary voltage dropping resistances is proabbly adequately free from ripple. It should be mentioned that the mains have such a large capacity that a condenser C (in dotted lines) of, say, 2 mfd. shunted across them serves no useful purpose.

A more ambitious double filter is illustrated in Fig. 2 (b). This arrangement will remove ripple from even the "roughest" mains.

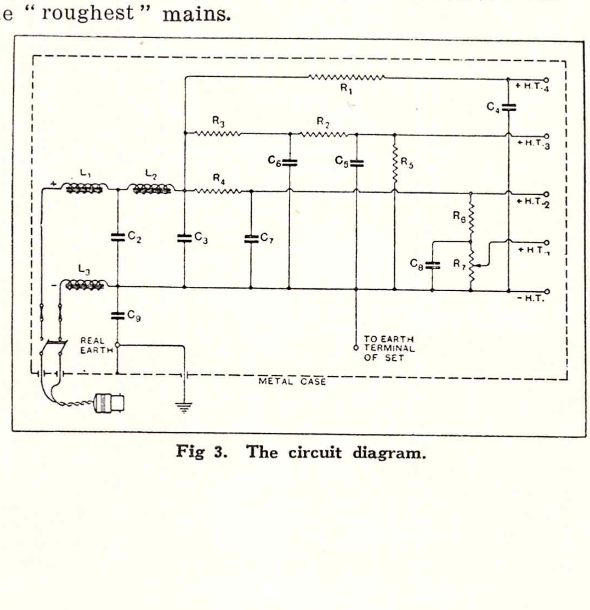


Fig 3. The circuit diagram.

THE FINAL CIRCUIT

The complete circuit diagram of the eliminator is shown in Fig. 3, the components being as follows :—

The Chokes : L_1, 30 henrys; L_2, 20 henrys; L_3, 10 henries. All these chokes must be capable of handling the total plate current of all the valves.

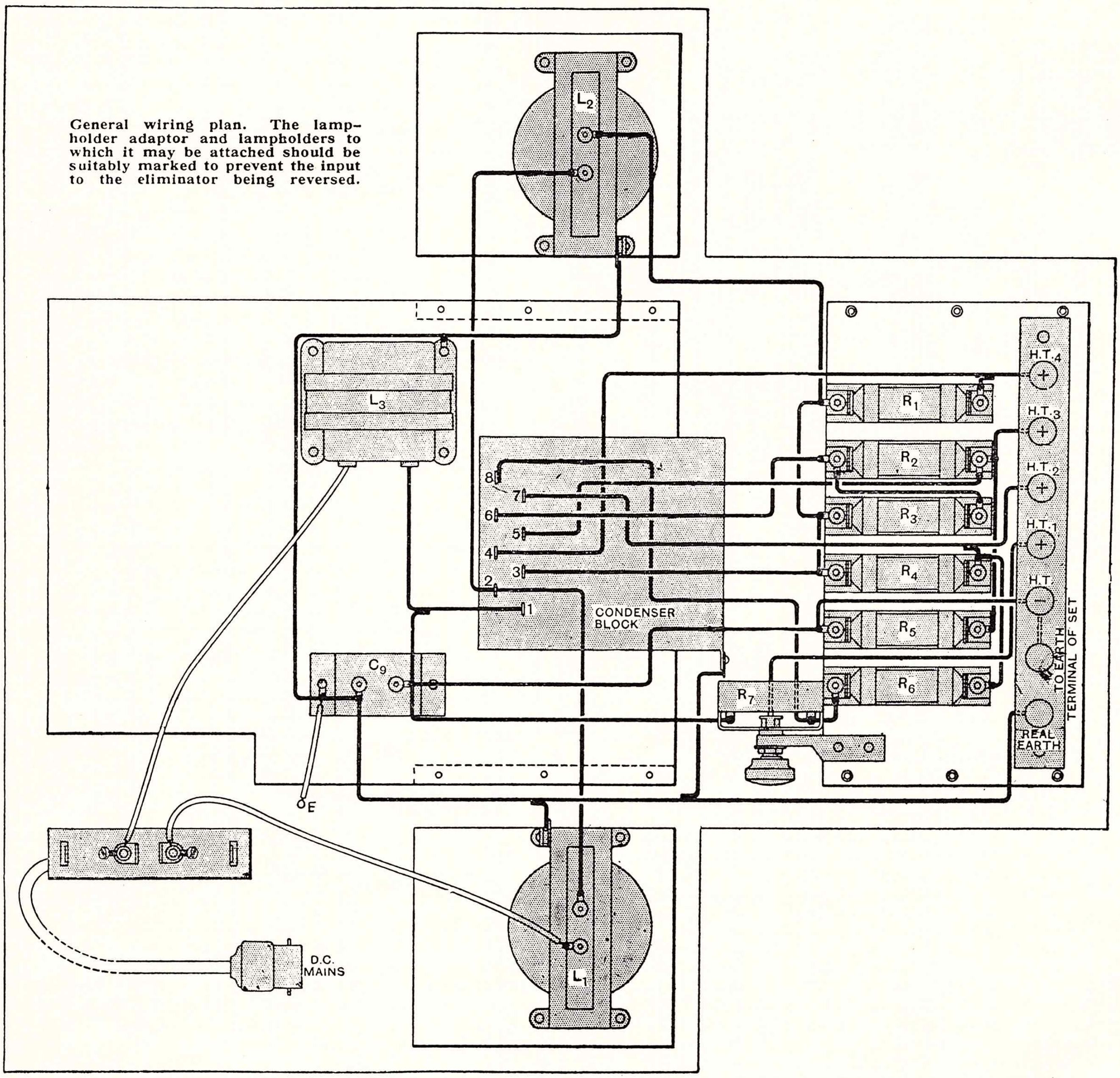
The Condensers : The condensers should be rated to withstand a working voltage of at least 250 and may be single condensers or of the type incorporated in block form for eliminator work.
C_2, 4 mfd; C_3, 4 mfd; C_4, C_5, C_6, C_7, C_9, each 2 mfd; C_8, 1mfd.

The Resistances : The function of the various resistances is to cause voltage drops so that the proper voltages may be applied to the plates of the various valves. Their values will be determined by the valves which are to be used and may be calculated in a manner similar to that described for our A.C. eliminators. It should be noticed that there will be voltage drops in the chokes, but these are easily calculated from the law that

Volts dropped = resistance in ohms x current in amperes.

The resistances are of the interchangeable type and so the eliminator may be adapted for 3-, 4- and 5-valve sets having various circuits.

The power valve in the last stage will be connected to H.T.4 and the resistance R_1 for a valve taking 20 milamps at 150 volts will be about 4000 ohms. This resist-



General wiring plan. The lampholder adaptor and lampholders to which it may be attached should be suitably marked to prevent the input to the eliminator being reversed.

ance, as well as the others in the eliminator, must be able to carry the current taken by the respective valves. Should the last valve require a voltage of about 210 the resistance R_1 may be dispensed with.

The detector will connect to H.T. 3 and R_2, R_3 may each be 10,000 ohms. For anode bend rectification, R_5 would be 40,000 ohms, but this resistance is omitted for for the more usual leaky grid rectification.

The plates of the S.G. valves will connect to H.T. 2 and for the average European valve R_4 should have a resistance of 10,000 ohms. The screen-grid voltages will be obtained from H.T. 1. The resistance R_6 may have a resistance 10,000 ohms, while R_7, which is a 25,000-ohm wire-wound potentiometer, serves to control the screen-grid voltage for best results or acts as a volume control.

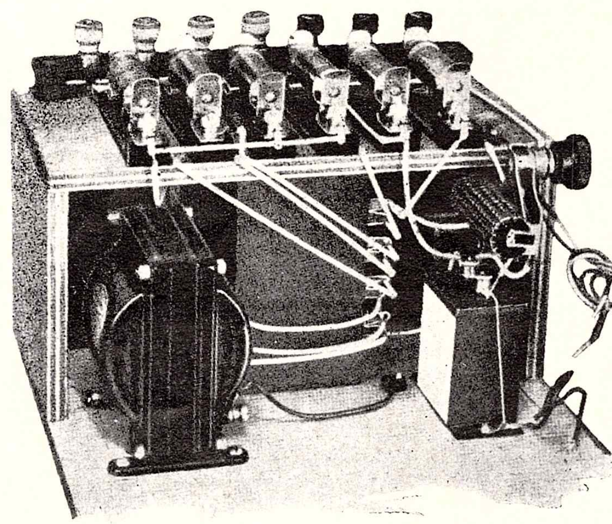


Fig. 5. On the right can be seen the earth condenser above which is the variable wire-wound potentiometer for critical screen voltage control.

The function of the fixed resistance R_6 in series with the potentiometer is to prevent the screen-grid voltage from rising too high, with consequent shortening of the life of the valve, as adjustments of R_7 are made.

BUILDING THE ELIMINATOR

A possible lay-out of the components is shown in Fig. 4, while Fig. 5 is a photograph of the completed unit. A double-pole single-throw switch is incorporated together with protective one-ampere fuses in each lead.

A WARNING

It must be remembered that with a positive neutral, the screening, aerial, loud speaker terminal, low-voltage accumulator and part of the wiring may be at a voltage of approximately 200 to earth. If bodily contact with any of these parts were made, shock would result which might easily be fatal if an earthed object were being touched at the same time. If the eliminator is separate from the set it should be housed in an earthed metal case with a lid of such type that when it is opened the mains are disconnected from the eliminator and the set. Further precautions should be adopted to ensure that as many of the external parts of the set as possible are not "alive." If the aerial-earth circuit of the receiver belongs to the isolated loose-coupled variety, a lead must be taken from the receiver earth to the terminal marked "earth terminal of set" on the eliminator unit. To prevent the possibility of shock from the aerial, a series aerial condenser, if not already embodied, should be fitted **inside** the receiver. The loud speaker can be isolated with an output transformer, or, if a choke-filter output is employed, condensers on **both** sides of the speaker are necessary. To give absolute immunity from shock the receiver and eliminator should really be housed in one box the lid of which, when lifted, could be arranged to disconnect the mains. We should like to emphasise that the warning given here should be taken seriously.

TRACING RESONANCES IN LOUDSPEAKERS

THE presence of a resonant frequency in some one or other of the parts of a loud speaker is a not unknown phenomenon; it may be due to the paper cone, to loose wire, to a screw or nut that has worked itself loose, or to any one of a dozen other causes. The audible symptom is usually a rattle or buzz that occurs only at certain notes in the music.

While a buzz of this kind is usually easy enough to remedy, once the cause is found, it is generally surprisingly difficult to locate, for it seems to come from all parts of the speaker at once. Nor is the search made easier by the fact that the objectionable noise is only intermittently excited by one particular note, for by the time one has realised that the speaker is buzzing again the note is over, and the buzz has stopped before one has had any chance of tracing it.

Alittle judicious law-breaking comes to our rescue here. If the receiver is set oscillating, and the tuning is varied until the beat-note between it and a station has the pitch that produces the buzz, one can go over the buzzing speaker at leisure and trace the noise, now made continuous, to its source. The tuning of the oscillating receiver must be carried out with extreme slowness, for the beat-note will pass over the whole audible range in response to a mere touch on the tuning dial. With a slow-motion condenser, however, there is seldom any real difficulty in finding the note to which the speaker responds.

In carrying out this test, consideration for one's neighbours makes it essential to disconnect the aerial before setting the receiver oscillating on the wavelength of the local station. If the listener lives at some distance from the nearest station it may be found impossible to obtain a sufficiently loud beat-note with no aerial; in such a case the receiver should be tuned to a foreign transmitter, and on no account to the one upon which the district as a whole depends for its programmes.

ELECTRICITY AND THE ELECTRON THEORY

BY H. P. V. BROWN (ZL3CG) CHRISTCHURCH

TO learn the nature of electricity we need to study the structure of the atom. Now the smallest particle of matter of any description is termed an atom and comparatively recent discoveries have proved that an atom consists of a central core or nucleus, called a proton, together with one or more electrons. The hydrogen atom which has one electron only and is at the bottom of the scale. The electron is a negative particle of electricity and is considered by some scientists to be a definite and peculiar modification of the ether of space. The proton carries a positive charge which is exactly balanced by the negative electron. Atoms of other elements have more than one electron, in fact the number is in step with the atomic weight and so uranium has 92 electrons and therefore its proton is more positive than the hydrogen proton, as it requires such a large number of electrons to keep it balanced, or electically neutral. Electrons in the different elements are all similar and it is the protons which differ and determine what particular element is represented.

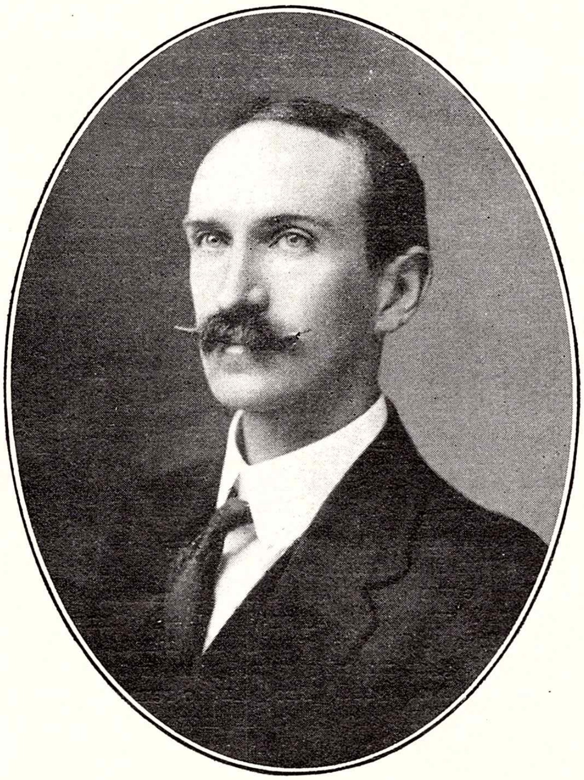
If an electron were removed from an atom by any means, such as by friction, or chemical action, etc., the atom would be positively charged and would endeavour to obtain another electron to restore itself to its normal neutral condition. On the other hand, if extra electrons were to be added to an atom, it would be negatively charged and would try to dispose of its surplus to other atoms in a manner which will be explained by an analogy further on in this article. When an atom has a deficiency or surplus of electrons it is an ion (which means carrier) and it will therefore be a positive or negative ion, respectively. It has been found that the atoms of some elements part with their electrons very readily and that others hold theirs most tenaciously. Metals belong to the former group whilst such substances as glass, bakelite, sulhpur, mica etc., belong to the latter. Metals are therefore good conductors but the other group mentioned are good insulators. Between the two classes there are substances which are moderately good conductors or poor conductors, etc.

Before leaving this portion of the subject, let us compare an atom with our solar system and it will be found that there is a distinct similarity. Our sun is the centre of a planetary system and has a certain number of planets which revolve around it, our earth being the third nearest. So it is with an atom, there being the proton in the centre and around it speed the electrons, termed planetary electrons, in definite orbits situated at, comparatively, very great distances from the proton. Filling the spaces between is the ever pervading ether of space. Assuming that the proton and the electron of a hydrogen atom are of similar size, though the latter is only one-eighteen hundredth the mass of the former, and that they were magnified until they were the size of a full stop, as shown on this page, then the two would be some forty feet apart. It seems difficult to realise that matter is therefore not really solid! It can now be understood how experimenters have been able to shoot electrons through a very thin sheet of platinum fused into the wall of a special type of electron tube, where very high voltages are used to develop sufficient speed for the purpose. The electrons can pass through the spaces between the parts of the atoms, not necessarily in a straight path, for there would not be merely one layer of atoms to go through, but very many even in the thinnest platinum "window," and there would be certain to be many collisions with protons and electrons in the plantinum. In fact some of the speeding electrons would be stopped by such collisions especially if several occurred in succession, whilst others would strike some of the atoms with sufficient energy to drive electrons out and such electrons would then be forced out, joining those that passed right through. A very thin platinum window, by the way, has to be supported upon a network of a stiffer build to prevent it bursting from the suction effect of the vacuum within the tube. If a distant star were to shoot into our solar system there would be almost unlimited space for it to pass right through without actually colliding with the earth or any of the planets, but, if a number appeared at one time, a collision or collisions would be more probable. When electrons, in a special electron tube, are set into motion, there are countless millions streaming against the platinum window and therefore collisions would be numerous, though possibly the bigger majority would pass through with but little diminution of speed. The point to remember is, that, matter is not solid, though to us mortals it appears to be.

To depart for a while from the realm of electrons, let us consider what happens if two air tanks are connected together by a pipe which has a tap in it, and then the air pressure is varied in these tanks. If air were pumped into one tank and then the tap was turned on, it is quite clear that some of the extra air would flow into the other tank until the pressure in both was equal. If both tanks were of similar size, exactly half the surplus air would flow into the second receptacle, whilst the quantity would be either more or less than half respectively, if the second tank were larger or smaller. A reverse condition would take place if air were pumped from one tank and then the tap was turned on. In this instance there would be a movement of air from the second tank into the partially emptied one until pressure was again equalised.

We can now take electrical conditions which are on a par with those just given above. Picture two metal spheres each upon an insulated support and with a connecting wire, in the centre of which is a switch for making or breaking the circuit. With the switch open, (circuit broken), suppose one sphere were to have electrons added to it and then the switch was closed. There would then be a passage of some of the surplus electrons to the other sphere until the electrical tension, or potential as it is commonly called, on both was equalised, and each would then be negatively charged. Again, if the spheres were neutralised by momentarily connecting to earth and the

switch was opened and then electrons were removed from one of the spheres, (by connecting it to the positive terminal of a frictional electrical machine, for example) and then the switch was closed once more, the positively charged sphere would rob the other (neutral) sphere of electrons until the potential on both was again equal. In this case as each sphere was finally deficient in electrons, they would be said to be positively charged, and have a positive potential.



Mr. H. P. V. BROWN

One more illustration will just about cover ordinary electrical conditions. The spheres are neutralised and then electrons are added to one sphere and at the same time the other sphere has electrons removed from it whilst the switch is open. The switch is now closed and electrons flow from the negatively charged sphere to the positively charged one, there being a greater attraction between the two charges because they are opposite. If now electrons could be steadily added to the one previously negative and at the same time electrons were withdrawn from the one formerly positive there would be a steady stream of electrons across the connecting wire as long as the process continued. This latter condition is what occurs if the two terminals of a battery are joined together. The battery could be connected to the two spheres, for instance, and before the switch was closed the sphere connected to the negative terminal would become as negative as that end of the battery and the other sphere would be positive.

Now the manner in which electricity flows in a conductor is as follows. Using a battery as a source of supply, there would be, as a result of the chemical action, an accumulation of electrons, or negative particles of electricity, on the negative plate and terminal, whilst at the positive there would be a corresponding deficiency, and when the circuit was completed electrons would be repelled from the negative plate and simultaneously drawn in at the positive terminal. (Note :—There is always neutral repulsion between negative and positive ions.) The planetary electrons in the connecting wire would take part in the general movement, but there would not be just a steady progression of electrons. If we could follow the track of these electrons we would find that there were innumerable collisions with the stationary protons as well as with other electrons, some of which were still held in the parent atoms of the wire. Some of the travelling electrons would be stopped, others momentarily slowed, whilst some of the electrons in the conductors would be driven on by collisions forcing them from the restraining action of the protons. The net result, however, would be a steady stream of electrons proportionate to the electrical potential between the battery terminals. The "current" of electricity would at the same time be inversely proportional to the "resistance" of the conductor. With a mental picture of innumerable collisions in the wire we can imagine what this resistance is. It can also be considered as the force required to move electrons from one atom to another. The collisions, partial or complete as the case may be, cannot take place without the expenditure, or using up, of energy and appears in the form of heat. Heat is always generated, but if the conductor is of sufficient size easily to carry all the electrons which the battery is driving around the circuit, this heat is more readily dissipated or radiated to the atmosphere, etc., due to the large surface and the wire does not become perceptibly warm. Also, fewer of the electrons in the conductor would be needed to maintain the current.

Suppose the conductor is of small diameter, it might become red hot or even fuse because the atoms are vibrated so much by electronic collisions. Numbers of electrons in the atoms of the connecting wire might even be thrown completely out of the wire, but they would not travel more than a minute fraction of an inch on account of further collisions, this time with the atoms of the air. However, if a red hot conductor were enclosed within a glass bulb which was evacuated of air to a high degree, electrons thrown off would not be impeded and a cloud of electrons would be present throughout the interior of the bulb. This is exactly the condition which pertains in the ordinary radio valve. A heated filament has electrons "boiled" out of it by means of a current of electricity from the mains or other source of supply.

Electrons can also appear in the flame of a bunsen burner as Edison discovered many years ago, though he did not realise what he had found out. Edison ascertained that an insulated object placed in a bunsen flame became charged with electricity and further investigation showed that if a circuit were made by means of a battery joined up so that the positive terminal was connected to the conductor in the flame and the negative terminal to the bunsen burner itself, a minute current of electricity flowed around, but there was no flow if the battery were reversed. This has been called the "Edison" effect and was the forerunner of the modern wireless valve. It is only necessary to insert a piece of metal, which will withstand a high temperature if necessary, in a bulb which is evacuated and contains a heated filament and to connect this plate to the positive connection on a battery and a current will flow. However the circuit must be completed by joining the negative terminal of this battery to the filament. There is no need to detail the construction of the valve but credit must be given to Fleming, who made practical use of Edison's discovery,

and also to Dr. de Forest who later invented the idea of inserting a grid. One more point to note and that is that experimenters are ever keen to try different substances in an endeavour to perfect a so called cold valve. By a cold valve is meant one where the temperature of the filament is very low so that little heat is generated and the life of the filament prolonged so far as a tendency to burn out is concerned. This is very near achievement by the use of certain substances which are extremely rich in electrons and what is more important, part with them at a low temperature. Some of these substances have but little strength and so filaments are coated or impregnated with them.

A brief mention of some of the methods for producing a flow of electricity will complete this article, but it must be understood that an actual current flows only when there is a complete circuit, but the "tendency" to flow can be set up. Chemical action between a metal (or metals) in certain solutions, termed electrodes and electrolytes, respectively, will produce a current. Friction between substances is utilised also, and the machine generally takes the form of a revolving glass, ebonite or other disc upon which are tinfoil segments. There are also rubbers, as well as a means of collecting the charges which are built up on the segments. If two dissimilar metal wires or strips are joined, and the junction is heated, a current will flow if the free ends are joined. There is, last but not least, the dynamo, or generator, which briefly, operates by making coils of insulated copper wire rotate in a strong magnetic field, the movement of the copper conductors across the magnetic lines of force (called flux lines etc.) setting up a flow of electrons in the copper wires. There are also several ways in which electrical action takes place in nature, the ionisation of the upper portion of our atmosphere by the effect of the sun's rays being one of the most important. Plant life and the formation of green colouring matter in plants depends upon the sun's action too. However, enough has been covered to give a slight idea of the wonderful electron and its effects.

A.C. AND D.C. CURRENT

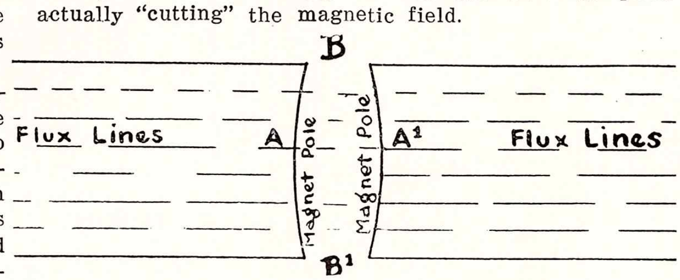
A BRIEF OUTLINE OF DIFFERENCES IN CURRENT FLOW

BY H. P. V. BROWN

THE differences between A.C. and D.C. current are undoubtedly numerous and would occupy considerable space to discuss in detail. These numerous and sometimes apparently minute but nevertheless important differences are of great importance to the expert electrician. The average radio enthusiast is, however, chiefly interested in the main differences between the A.C. and D.C. current, and the following notes are given to describe these differences as briefly as possible and in simple language. Nothing more has been attempted in this short article than to explain briefly to the uninitiated the differences in flow of the two types of current.

Direct current is a smooth, steady current, and consists of a stream of electrons coming from the negative source of supply and passing via the external circuit to the positive source. Alternating current is like a pendulum in a sense. However, imagine a water pump which starts up (the quantity of water flowing increasing as the pressure rises). Then suppose the pump is stopped and the pressure quickly falls. Then the pump is reversed, etc.

When a D.C. machine starts up, the moment the normal speed is reached, the voltage and current are a maximum and remain steady (assuming the load on the line is steady, for other conditions arise then, but they need not be considered when just studying the simple difference between A.C. and D.C.). Now the fundamental way a current is generated in a D.C. or A.C. generator, is the same. Any conductor (wire) cutting the electromagnetic line of force stretching between the poles of a magnet (permanent or electro-magnet) generates a current, or in other words, tends to do so; for a current cannot flow unless the circuit is completed (externally or in the machine itself—latter condition being a short circuit). The voltage set up is according to definite laws: so many electro-magnetic "lines of force" (called flux lines, also) "cut" or intersected by the conductor (or conductors) per second. Speed of rotation, therefore, has a definite bearing. A conductor coiled to make more conductors (in series, because the whole conductor is one wire) obviously raises the voltage. The "ends" of the turns do not cut a flux at right angles, therefore, they merely act as connections between the different parts actually "cutting" the magnetic field.



According to Lenz's Law (I think it is) there is a definite direction of current flow depending upon the direction in which (a) the conductor(s) turn, (b) the lines of force lie. For example, the conductor can be moved downwards through the flux lines or upwards, and the current direction depends upon which way it moves. Again, in a single coil rotating between two poles, due to the angular way the lines are cut, the most lines are cut at A and A^1: at B and B^1 the lines are practically nil. Once again a single conductor rotating will develop an alternating current which is zero at, say, B, then it is building up to a maximum at A falls to zero again at B^1, reaches a maximum at A^1 (in reverse direction) and back to zero at B. And so on ad lib.

AMATEUR SECTION

Amateur Transmission

(By R. J. ORBELL, B.E., A.A.I.E.E.)

COMPARATIVELY few radio fans in New Zealand realise the amount of enjoyment they might derive by going in for transmitting. No doubt one of the reasons why many have been backward in taking up transmitting is that a popular belief exists that it is an expensive hobby, hence they cannot afford more than an ordinary broadcast receiver. That this belief is a fallacy may be seen readily by a perusal of the apparatus and circuits about to be described. Of course, as with anything else, transmitting apparatus may become expensive if the owner desires to elaborate on the essential equipment, especially when high power is used.

Generally, it is not realised, however that with apparatus costing from five to six pounds it is possible to transmit, signals to America, or even Europe, comparatively easily, and with the addition of a receiver costing less than half of the above amount to build it is possible to hold-two way communication with hundreds of fellow amateurs using similar equipment in any of about 50 different countries. Such are the peculiarities of short-wave transmission, that by the expenditure of energy less than that required to light the tail lamp of a motor car, signals can be sent around the world with no difficulty; whereas were long waves employed, many thousands of times greater power than this would be required, and even then results would be uncertain.

The accompanying photograph shows a simple transmitter using one UX210 valve, with the two necessary variable condensers, which are of the ordinary receiving type, together with two inductance coils wound on an insulated former. It will be noticed that the layout is really remarkably simple and easy to construct.

The wiring diagram of this transmitter is shown in Fig. 1, and is known as a Hartley circuit, a very efficient arrangement commonly used by amateurs all over the world.

The positive and negative of the plate supply enter the transmitter at B + and B — respectively. The source of plate supply may be from ordinary B batteries for very low power, although it is advisable to use a chemical rectifier in connection with the A.C. house supply as will be described later.

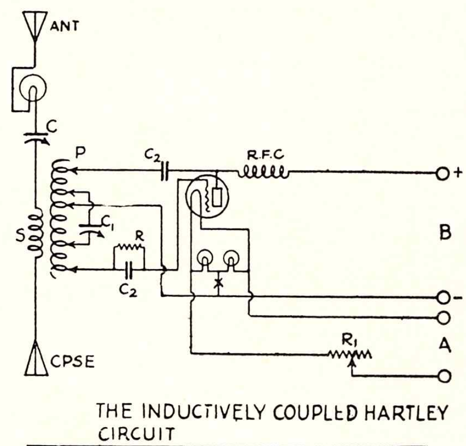
The filament supply may be from an ordinary storage battery such as is used for a broadcast receiver. This is connected to the transmitter at A in Fig. 1. A more satisfactory method is to discard the storage battery and make use of a small transformer delivering the required filament voltage, or a little higher, at its secondary terminals. Transmitting valves may be operated equally well with either DC or AC on their filaments, and a small transformer is cheaper and simpler than a storage for theis purpose.

Two small torch bulbs are shown connected directly across the filament leads. The centre point of these bulbs connects through the morse key, shown as a cross to the negative of the plate supply. If a centre tap were provided on the filament transformer, these lamps could be omitted , also if a battery were used instead of a transformer, the lamps would not be required. Their purpose is to form an artificial centre tap to eliminate hum.

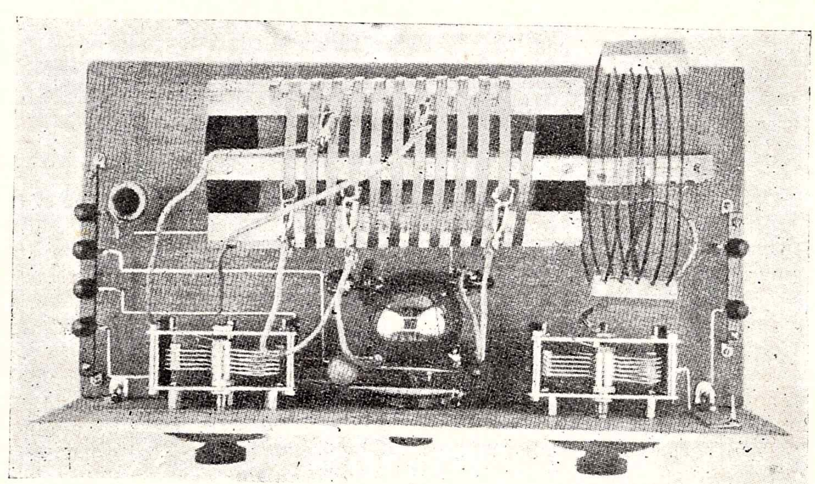
C2 is an ordinary .00025 grid condenser shunted by a grid leak as with a receiving set. The valve of this leak, however, is much lower than that in use on a receiver. Its value generally is about 10,000 or 20,000 ohms. The radio frequency choke connected between the positive of the plate supply and the plate of the valve, marked R.F.C., also is different and more simple than a receiving choke.

It consists of about 200 or 300 turns of the fine insulated wire wound on an ordinary dowel stick, a very simple component to build.

In the aerial lead is a small lamp, the size of which

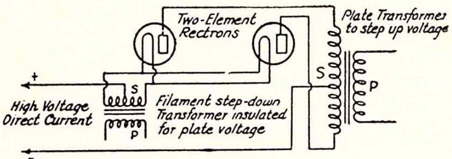


SCHEMATIC DIAGRAM FOR SIMPLE LOW POWER TRANSMITTER



Simple Low-power Sending Set. Note carefully the position of the five clips on the coils

depends on the power to be used. Its purpose is to measure the amount of current passing into the aerial from the set. This takes the place of a meter as an approximate guide, but in its stead may be used a hot wire or thermo couple meter if desired. It should be noted, however, that the amount of current passing at this point is not commensurable with the power used. With certain aerial arrangements quite high power may be radiated with practically no current passing through at this point, the reason being that the indicated current is not constant right along the aerial wire, but varies according to the position of the lamp or meter along the wire. In general an earth connection is not used with a transmitter. Instead a counter-poise marked CPSE in the diagram is substituted. The whole aerial and counterpoise system, unlike the case with a receiving set, is tuned either directly to the wavelength being radiated or to some harmonic of it, such as twice, or three times the wavelength to which the transmitter itself is tuned.



TUBE RECTIFIER CIRCUIT

Owing to the fact hat the wavelengths in use by amateurs are confined to narrow bands in the neighbourhood of 20 metres, 40 metres and 80 metres, there would be much interference between different stations operating at once if the transmitted wavelength were not maintained quite steady. For this reason the various components should be arranged so that vibration cannot cause any unsteadiness.

Clips to go on the flatwise wound coils may be made of the same material as the coil winding itself of brass or copper ribbon is used. Copper ribbon from a Ford magneto is quite suitable for both these purposes. The two condenser leads are made as short as possible while allowing the coil to be a couple of inches away from the condenser. The majority of the apparatus of the transmitter proper, of which mention has not been made is explained by reference to the photograph and the diagram of connections.

With regard to the high-voltage power supply, the New Zealand regulations quite rightly do not allow of the use of "raw" A.C., because of the broadness or unsteady frequency which is associated with it, so that some form of rectifier and filter are necessary. The rectifier converts the alternating current from the secondary of the transformer into pulsating direct current, and the filter smooths out the resulting ripples till practically smooth D.C. results. Either full-wave or half-wave rectification may be used, although the former is preferable. However, quite good resuts may be had by the use of the half-wave method, provided a good filter is used.

A circuit for full-wave rectification is shown in Fig. 2, and a suitable filter is indicated in Fig. 3.

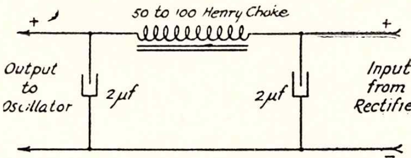
The rectifiers may be Radiotron UX281 tubes, or for low power, ordinary 201A tubes, with their plates and grids conencted together to form one element answer the purpose admirably.

When a UX210 transmitting tube is used as an oscillater, as shown in the photograph, it is capable of handling voltages as high as 600 volts or even higher, and the transformer must be wound to give about 650 volts to either side of the centre tap.

The beginner is advised, however, to build his first transmitter to make use of a 210A receiving tube as an oscillator, with, say, 100 or 150 volts from B batteries for the high voltage supply thus doing away with all transformers, rectifiers and filters. A milliammeter reading to about 20 or 30 milliamps should be inserted in the B battery circuit in order to enable adjustment of the circuit to combine with a good steady signal with low current consumption, thus preventing excessive drain on the batteries. With such a transmitter using a single 201A tube with B batteries, good signals may be sent over surpising distances. No trouble should be had in holding two-way conversation in morse with Australian amateurs, and under favourable conditions with American stations.

Our New Zealand P. & T. regulations require the beginner in transmitting to pass an examination in the essentials of valve operation, in the adjustment and operation of a simple transmitter, and in the regulations and abbreviations in common use.

The American Radio Relay League publishes a Radio Amateurs Handbook which contains all the information necessary to pass this examination. The prospective amateur is strongly advised to purchase this Handbook, also to subscribe to the A.R.R.L. monthly transmitting magazine Q.S.T., both of which may be obtained locally if required. There is a New Zealand Association of Transmitters, with headquarters at Wellington, which cares for the wants of the local amateur, and which anyone interested in transmitting is advised to join.



"BRUTE FORCE" FILTER CIRCUIT

The problem of learning the morse code is not a dofficult one, and much can be done with a little practice and a buzzer and key.

It is a good plan to build a simple two-tube short-wave receiver before attempting to construct a transmitter. With it, the beginner can listen to different stations working together, and get a better idea of what procedure is employed.

The fee for a transmitting licence has been reduced from two guineas to thirty shillings, so that if a receiving licence is held already, no additional cost is entailed in this respect when a transmitter is installed.

Together with his licence, the amateur is allotted a call sign, for use at his station.

The International Radio Convention, held at Washington, U.S.A., in 1927, decreed that all amateur call signs should have certain lettars prefixed to them as a means of identification as to what country they belong to. For instance all New Zealand amateur call signs start with the letters ZL, and all American amateur calls commence with the letters W or K depending on whether the station is in the U.S.A. or one of its Dependencies.

There are International abbreviations mostly starting with the letter Q. As will be seen by a perusal of the list here appended, a number of these abbreviations refer to commercial stations only, but nevertheless many of them are in constant use by amateur stations.

THE Q CODE

Abbreviation	Question.	Answer.
QRA	What is the name of your station?	The name of my station is ....
QRB	At what approximate distance are you from my station?	The aproximate distance between our stations is....... nautical miles (or .... kilometres).
QRC	By what private company (or government administration) are the accounts for charges of your station liquidated?	The accounts for charges of my station are liquidated by the .... private company (or by the government administration of ....).
QRD	Where are you going?	I am going to..............
QRE	What is the nationality of your station?	The nationality of my station is..............
QRF	Where do you come from?	I come from ....
QRG	Will you indicate to me my exact wave length in metres (or frequency in kilocycles)?	Your exact wave length is .... metres (or .... kilocycles).
QRH	What is your exact wave length in metres (frequency in kilocycles)?	My exact wave length is ....metres (frequency............kilocycles)
QRI	Is my tone bad?	Your tone is bad.
QRJ	Are you receiving me badly? Are my signals weak?	I cannot receive you. Your signals are too weak.
QRK	Are you receiving me well? Are my signals good?	I receive you well. Your signals are good.
QRL	Are you busy?	I am busy. Or, (I am busy with........................). Please do not interfere.
QRM	Are you being interfered with?	I am being interfered with.
QRN	Are you troubled by atmospherics?	I am troubled by atmospherics.
QRO	Must I increase power?	Increase power.
QRP	Must I decrease power?	Decrease power.
QRQ	Must I send faster?	Send faster (............words per minute).
QRS	Must I send more slowly?	Send more slowly (...........words per minute).
QRT	Must I stop sending?	Stop sending.
QRU	Have you anything for me?	I have nothing for you.
QRV	Must I send a series of V's?	Send a series of V's.
QRW	Must I advise .... that you are calling him?	Please advise................that I am calling him.
QRX	Must I wait? When will you call me again?	Wait until I have finished communicating with................. I will call you immediately (or at ....o'clock).
QRY	Which is my turn?	Your turn is No.............. (or according to any other indication).
QRZ	By whom am I being called?	You are being called by............
QSA	What is the strength of my signals (1 to 5)?	The strength of your signals is..........(1 to 5).
QSB	Does the strength of my signals vary?	The strength of your signals varies.
QSC	Do my signals disappear entirely at intervals?	Your signals disappear entirely at intervals.
QSD	Is my keying bad?	Your keying is bad. Your signals are unreadable.
QSE	Are my signals distinct?	Your signals run together.
OSF	Is my automatic transmission good?	Your automatic transmission fades out.
QSG	Must I transmit the telegrams by a series of 5, 10 (or according to any other indication)?	Transmit the telegrams by a series of 5, 10 (or according to any other indication).
QSH	Must I send one telegram at a time, repeating it twice?	Transmit one telegram at a time repeating it twice.
QSI	Must I send the telegrams in alternate order without repetition?	Send the telegrams in alternate order without repetition.
QSJ	What is the charge to be collected per word for .... including your internal telegraph charge?	The charge to be collected per word for.............is.............francs, including my internal telegraph charge.
QSK	Must I suspend traffic? At what time will you call me again?	Suspend traffic. I will call you again at..........(o'clock).
QSL	Can you give me acknowledgment of receipt?	I give you acknowledgment of receipt.
QSM	Have you received my acknowledgment of receipt?	I have not received your acknowledgment of receipt.
QSN	Can you receive me now? Must I continue to listen?	I cannot receive you now. Continue to listen.
QSO	Can you communicate with .... directly (or through the intermediary of..............)?	I can communicate with .... directly (or through the intermediary of........).
QSP	Will you relay to.................. free of charge?	I will relay to...........free of charge.
QSQ	Must I send each word or group once only?	Send each word or group once only.
QSR	Has the distress call received from .... been attended to?	The distress call received from.............. has been attended to by ....
QSU	Must I send on .... metres (or .... kilocycles) waves of A2, A3 or B?*	Send on........metres (or on...........kilocycles), waves of Type A1, A2, A3 or B.* I am listening for you.
QSV	Must I shift to the wave of ....metres (or of .... kilocycles), for the balance of our communications, and continue after having sent several V's?	Shift to wave of.............metres (or of .... kilocycles) for the balance of our communications and continue after having sent several V's.
QSW	Will you send on ...... metres (or on ....kilocycles) waves of type A1, A2, A3 or B?*	I will send on ....metres (or........kilocycles) waves of Type A1, A2, A3 or B.* Continue to listen.
QSX	Does my wave length (frequency) vary?	Your wave length (frequency) varies.
QSY	Must I send on the wave of......metres (or......kilocycles without changing the type of wave?	Send on the wave of..........metres (or kilocycles) without changing the type of wave.
QSZ	Must I send each word or group twice.	Send each word or group twice.
QTA	Must I cancel telegram No.........as if it had not been sent?	Cancel telegram No............as if it had not been sent.
QTB	Do you agree with my word count?	I do not agree with your word count; I shall repeat the first letter of each word and the first figure of each number.
QTC	How many telegrams have you to send?	I have........telegrams for you or for.........

QTD—Is the word-count which I am confirming to you accepted?	The word count which you confirm to me is accepted.
QTE—What is my true bearing? (or) What is my true bearing relative to?	Your true bearing is........degrees (or) Your true bearing relative to........is........degrees at..........(o'clock).
QTF—Will you give me the position of my station based on the bearings taken by the radiocompass stations which you control?	The position of your station based on the bearings taken by the radio-compass stations which I control is........latitude........longitude.
QTG—Will you transmit your call signal for one minute on a wave length of .... metres (or...... kilocycles) in order that I may take your radio-compass bearing?	I am sending my call signal for one minute on the wave length of .... metres (or.......... kilocycles) in order that you may take my radio-compass bearing.
QTH—What is your position in latitude and longitude (or according to any other indication)?	My position is....... latitude........longitude (or according to any other indication).
QTI—What is your true course?	My true course is..........degrees.
QTJ—What is your speed?	My speed is.......... knots, or...........kilometers per hour.
QTK—What is the true bearing of........relative to you?	The true bearing of .... relative to me is .... degrees at ..... (o'clock).
QTL—Send radio signals to enable me to determine my bearing with respect to the radio beacon.	I am sending radio signals to permit you to determine your bearing with respect to the radio beacon.
QTM—Send radio signals and submarine sound signals to enable me to determine my bearing and my distance.	I am sending radio signals and submarine sound signals to permit you to determine your bearing and your distance.
QTN—Can you take the bearing of my station (or of.........) relative to you?	I cannot take the bearing of your station (or of.........) relative to my station.
QTP—Are you going to enter the dock (or the port)?	I am going to enter the dock (or the port).
QTR—What is the exact time?	The exact time is...........
QTS—What is the true bearing of your station relative to me?	The true bearing of my station relative to you is ....at.......... (o'clock).
QTU—What are the hours during which your station is open?	My station is open from ....to..........

MISCELLANEOUS ABBREVIATIONS

ABBREVIATION	MEANING
C	Yes.
N	No.
P	Announcement of private telegram in the mobile service (to be used as a prefix).
W	Word or words.
AA	"All after . . . ." (to be used after a question mark to request a repetition).
AB	"All before . . . ." (to be used after a question mark to request a repetiton).
AL	"All that has just been sent" (to be used after a question mark to request a repetition).
BN	"All between......" (to be used after a question mark to request a repetition).
BQ	Announcement of reply to a request for rectification.
CL	"I am closing my station."
CS	Call signal (to be used to ask repetition of a call signal).
DB	"I cannot give you a bearing, you are not in the calibrated sector of this station."
DC	"The minimum of your signal is suitable for the bearing."
DF	Your bearing at .... (o'clock) was .... degrees, in the doubtful sector of this station, with a possible error of two degrees.
DG	Please advise me if you note an error in the bearing given.
DI	Bearing doubtful in conssequence of the bad quality of your signals.
DJ	Bearing doubtful because of interference.
DL	Your bearing at .... (o'clock) was .... degrees in the doubtful sector of this station.
DO	Bearing doubtful. Ask for another bearing later, or at ...... (o'clock).
DP	Beyond 50 miles, possible error of bearing can attain two degrees.
DS	Adjust your transmitter, the minimum of your signal is too broad.
DT	I can not furnish you with a bearing; the minimum of your signal is too broad.
DY	This station is bilateral, what is your approximate direction in degrees relative to this station?
DZ	Your bearing is reciprocal (to be used only by the central station of a group of radio-compass stations when it is addressed to other stations of the same group).
ER	"Here......." (to be used before the name of the mobile station in the sending of route indications).
GA	"Resume sending" (to be used more especially in the fixed service).
JM	"If I may send make a series of dashes. To stop my transmission make a series of dots." Not to be used on 600 metres (500 kilocycles).
MN	Minute or minutes (to be used to indicate the duration of a wait).
NW	"I resume transmission" (to be used more especially in the fixed service.)
OK	"We are in agreement."
RQ	Announcement of a request for rectification.
SA	Announcement of the name of an aircraft station (to be used in the sending of indications of passage).
ST	Announcement of the name of an aeronautic station.
SF	Announcement of the name of an aeronautic station.
SN	Announcement ot the name of a coast station.
SS	Announcement of the name of a ship station (to be used in the transmission of indications of passage).
TR	Announcement of the request or of the sending of indications concerning a mobile station.
UA	"Are we in agreement?"
WA	"Word after. . . . ." (to be used after a question mark to request a repetition).
WB	"Word before . . . ." (to be used after a question mark to request a repetition).
XS	Atmospherics.
YS	"See your service advice."
ABV	"Shorten the traffic by using the International Abbreviations" or "Repeat (or I repeat) the figures in abbreviation form."
ADR	Address (to be used after a question mark to request a repetition).
CFM	"Confirm" or "I confirm."
COL	"Collate" or "I Collate."
ITP	"The punctuation counts."
MSG	Announcement of telegram concerning ship service only (to be used as a prefix).
PBL	Preamble (to be used after a question mark to request a repetition).
REF	"Referring to............." or "Refer to ...."
RPT	"Repeat" or "I repeat" (to be used to ask or to give repetition of all or part of the traffic by making the corresponding indication after the abbreviation).
SIG	Signature (to be used after a question mark to request a repetition).
SVC	Announcement of service telegram concerning private traffic (to be used as a prefix).
TFC	Traffic.
TXT	Text (to be used after a question mark to request a repetition).

Ham Abbreviations

IN amateur work the following abbreviations are also used, together with many other abbreviated words usually composed "on the spur of the moment." Study of abbreviations brings to light some methods that may be followed in coining abbreviations.

(1) A method much used in short words is to give the first and last letters only, eliminating all intermediate letters in the word. Examples: Now, nw; check ck; would, wd.

(2) Another method uses consonants only, eliminating all intermediate letters in the word. Examples: Letter, ltr; bound, bnd; message, msg; received, rcd.

(3) A third method consists of using phonetic spelling. Examples: Some, sum; good, gud; says, sez; night, nite.

4. Replacing parts of a word with the letter "X" is a method occasionally used in abbreviating. Examples: Transmitter, xmtr; weather, wx; distance, dx; press px.

ABL	Able
ABT	About
AC	Alternating Current
ACCT	Account
ACCW	Alternating current C. W. (Not rectified before application to plate circuit of transmitting tubes)
ADR-ADS-ADSD	Address, addressed
AER	Aerial
AGN	Again
AHD	Ahead
AMP	Ampere
AMT	Amount
ANI	Any
ANT	Antenna
ARL	Aerial
ART	All right
AST	Atlantic Standard Time (1 hour later than E.S.T.)
AUD	Audible, audibility
AUSSIE	Australian amateur
B	Be
B4	Before
BCL	Broadcast listener
BD	Bad
BI	By
BK	Break, back
BKG	Bookkeeping, breaking
BLV	Believe
BN	Been, all between
BND	Bound
BPL	Brass Pounders' League
BTR	Better
BUG	Vibroplex key, amateur radio "fever"
C	See, correct, yes
CANS	Phones
CHGS	Charges
CK	Check
CKS	Chokes, circuits
CKT	Circuit
CL-CLG-CLD	Call, calling, called closing (station)
CM	Communications Manager
CN	Can
CNT	Can't cannot
COND	Condenser, condition
CONGRATS	Congratulations
CP-CPSE	Counterpoise
CRD	Card
CST	Central Standard Time
CUD-CD	Could
CUL	See you later
CUM	Come
CW	Continuous wave
CY	Copy
DA	Day
DC	Direct current
DFS	Disregard former service
DH	Dead head, service message
DLD-DLVD	Delivered
DLY	Delivery
DN	Done, down
DNT	Do not, don't
DPR	Day Press Rate
DSTN	Destination
DSTC	Delivered subject to correction
DUPE	Duplicate
DX	Distance
FR(E)	Here
EM	Them
ES	And
EST	Eastern Standard Time
EVDI	Everybody
EVY	Every
EZ	Easy
FB	Fine business, excellent
FIL	Filament
FLD-FLT	Filed, filing time
FM	From
FONES	Telephones
FR	For
FREQ	Frequency, frequently
GA	Go ahead (resume sending)
GB	Good-bye
GBA	Give better address
GE	Good evening
GEN	Generator
GES	Guess
GG	Going
GM	Good morning
GCT	Greenwich Civil Time
GMT	Greenwich Mean Time
GN	Gone, good night
GND	Ground
GCA	Get quick answer
GSA	Give some address
GUD	Good
GV-GVG	Give, giving
HA	Hurry answer
HAM	Amateur, brass-pounder
HD	Had, head
HI	Laughter, high
HR	Here, hear
HRD	Heard
HV	Have
HVY	Heavy
HW	How, hot wire, herewith
HWM	Hot wire meter
I	I understand
ICW	Interrupted continuous wave

INPT	Input
IMPT	Important
KNW	Know
LD-LID	"Lid," a poor operator, long distance
LITE	Light
LTR	Later, letter
LW	Low
MA	Milliampere
MANI	Many
MG	Motor-generator
MGR	Manager
MILS	Milliamperes
MI	My
MIN	Minute
MIM	Exclamation
MITY	Mighty
MK	Make
MO	Month, master oscillator
MST	Mountain Standard Time
MTR	Meter
N	Nil, nothing, no
ND	Nothing doing
NG	No good
NIL	Nothing
NITE	Night
NM	No more
NO	Know
NPR	Night Press Rate
NR	Number, near, no record
NSA	No such address
NT	Not
NTG	Nothing
NW	Now (I resume transmission)
NZ	New Zealand
OB	Old Boy, Official Broadcast
OFS	Office
OM	Old man
OO	Official Observer
OPN	Operation
OP-OPR	Operator
ORS	Official Relay Station
OSC	Oscillate, oscillations
OT	Oscillation transformer, old timer, old top
OW	Old woman
PRI	Primary
PSE	Please
PST	Pacific Standard Time
PT	Point
PUNK	Poor operator, lid
PUR	Poor
PWR	Power
PX	Press (news)
R	Are, all right, O.K.
RAC	Rectified alternating current
RCD	Received
RCVR	Receiver
RDO	Radio
RDS	Reads
RES	Resistance
RHEO	Rheostat
RI	Radio Inspector
RITE	Write, right
RM	Route Manager
RPT	Repeat, report
RUF	Rough
SA	Say
SCM	Section Communications Manager
SEC	Second
SED	Said
SEZ	Says
SHUD	Should
SIG-SG	Signature
SIGS	Signals
SINE	Sign, personal initials, signature
SINK	Synchronous
SITE	Sight
SKED	Schedule
SORRI-SRI	Sorry
SPK	Spark, speak
SUM	Some
TC	Thermo couple
TDA	To-day
TKS-TNX	Thanks
TNG	Thing
TMW	Tomorrow
TR	There, their position report
TRI	Try
TRUB	Trouble
TS	This
T	The
TT	That
TU	Thank you
U	You
UNDLD	Undelivered
UNKN	Unknown
UR	Your, you're
URS	Yours
V	Volt
VAR	Variable
VC	Variable Condenser
VT	Vacuum tube
VY	Very
WD	Would, word
WDS	Words
WN-WEN	When
WI-WID	With
WK	Work, weak, week, well-known
WKD	Worked
WKG	Working
WL	Will
WN	When
WO	Who
WT	What, wait, watt
WUD	Would
WV-WL	Wave, wavelength
WX	Weather
XMTR	Transmitter
XCUSE	Excuse
XPLN	Explain
XTRA	Extra
YDA	Yesterday
YL	Young Lady
YR	Your
ZEDDER	New Zealander
73	Best regards
88	Love and kisses
99	Keep out
2	Two, to, too
2DA	To-day
4	Please start me, where?, for, four
8	Eight, ate

International Prefixes

THE nationality of a radio station is shown by the initial letter or letters of the call signal assigned it by its government. These assignments are based on an international allocation of the alphabet embraced in the International Radio-telegraph Convention.

Amateur calls commonly consist of one or two initial letters to indicate nationality, a digit, and two or three additional letters.

Nations are obliged to select some letter or letters from their assignment to use as a prefix to amateur calls. The remainder of the call commonly consists of a numeral and two or three letters.

In the list which follows, the first column shows the allocation of call signals made in the Washington Convention. Every call of a nation must be taken from the block of letters assigned it. Thus this list is useful in identifying the nationality of any call heard, whether amateur or not. In the second column the amateur prefixes, the beginning letters of amateur calls, are listed. In most cases we know that these prefixes to have been officially designated by the government concerned, but in some cases we have listed, of our own initiative, the proper prefix when there can be no choice about it. For instance Haiti is assigned the calls from HHA to HHZ and therefore every Haitain call must begin with the letters HH, whether that Government so proclaim or not. In a few cases blanks are shown, where there is some choice and the Government concerned has not acted. For instance, one does not know, until Columbia acts, whether Colombian amateur calls will commence with HJ or HK. Where a prefix is shown in brackets it indicates that that government has more than one assignment of initial letters and that the indicated letter will be found assigned, in another part of the list, to that country.

Mr. W. M. Dawson operating ZL2XP at Napier during the recent earthquake

On the table at the left is the All-wave receiver, while at the right is the transmitter ZL2XP, No. 7.

LIST OF INTERNATIONAL PREFIXES

CAA-CEZ	CE	Chile
CFA-CKZ	[VE]	Canada
CLA-CMZ	CM	Cuba
CNA-CNZ	CN	Morocco, Algeria, Tunisia
CPA-CPZ	CP	Bolivia
CQA-CQZ[1]	CR	
CRA-CRZ	CR	Portuguese colonies
CSA-CUZ	CT	Portugal
CVA-CVZ	CV	Rumania
CWA-CXZ	CX	Uruguay
CZA-CZZ	CZ	Monaco
D	D	Germany
EAA-EHZ	EAR	Spain
EIA-EIZ	EI	Irish Free State
ELA-ELZ	EL	Liberia
ESA-ESZ	ES	Esthonia
ETA-ETZ	ET	Ethiopia (Abyssinia)
F	F	France (including colonies)
	FI	French Indo-China
G		Great Britain
	G	Great Britain except Ireland
	GI	Northern Ireland
HAA-HAZ	HA	Hungary
HBA-HBZ	HB	Switzerland
HCA-HCZ	HC	Ecuador
HHA-HHZ	HH	Republic of Haiti
HIA-HIZ	HI	Dominican Republic
HJA-HKZ	HJ	Republic of Colombia
HRA-HRZ	HR	Republic of Honduras
HSA-HSZ	HS	Siam
I	I	Italy and colonies
J	J	Japan
K		United States of America
	KA	Philippine Islands
	K4	Porto Rico and Virgin Islands
	K6	Territory of Hawaii
	K7	Alaska
LAA-LNZ	LA	Norway
LOA-LVZ	LU	Argentine Republic
LZA-LZZ	LZ	Bulgaria
M	[G]	Great Britain
N	[W]	United States of America
OAA-OBZ	OA	Peru
OCA-OCZ[1]		
OFA-OGZ[1]	OH	Finland
OHA-OHZ		
OKA-OKZ	OK	Czechoslovakia
ONA-OTZ	ON	Belgium and colonies
OUA-OZZ	OZ	Denmark
PAA-PIZ	PA	
	PB	The Netherlands
	PC	
PJA-PJZ	PJ	Curacao
PKA-POZ	PK	Dutch East Indies
PPA-PYZ	PY	Brazil
PZA-PZZ	PZ	Surinam
RAA-RQZ	RA	U.S.S.R. ("Russia")
RVA-RVZ	RV	Persia
RXA-RXZ	RX	Republic of Panama
RYA-RYZ	RY	Lithuania
SAA-SMZ	SM	Sweden
SPA-SRZ	SP	Poland
STA-STZ[1]	SU	
SUA-SUZ		Egypt
SVA-SZZ	SV	Greece
TAA-TCZ	TA	Turkey
TFA-TFZ	TF	Iceland
TGA-TGZ	TG	Guatemala
TIA-TIZ	TI	Costa Rica
TSA-TSZ	TS	Territory of the Saar Basin
UHA-UHZ	UH	Hedjaz
UIA-UKZ	PK	Dutch East Indies
ULA-ULZ	UL	Luxemburg
UNA-UNZ	UN	Yugoslavia
UOA-UOZ	UO	Austria
UWA-UZZ[1]	VE	
VAA-VGZ		Canada
VHA-VMZ	VK	Commonwealth of Australia
VOA-VOZ	VO	Newfoundland
VPA-VSZ		British colonies and protectorates
	VP	Bermuda, Br. Guiana, Zanzibar
	VQ	Northern Rhodesia, Kenya Colony, Fanning Island
	VS	Straits Settlements, Ceylon, Hong Kong, Malay States
VTA-VWZ	VT-VU	British India
W	W	U. States of America continental
XAA XFZ	X[2]	Mexico
XGA-XUZ	(AC)[3]	China
YAA-YAZ	YA	Afghanistan
YHA YHZ	YH	New Hebrides
YIA-YIZ	YI	Iraq
	YK	Formosa
YLA-YLZ	YL	Latvia
YMA-YMZ	YM	Free City of Danzig
YNA-YNZ	YN[4]	Nicaragua
YSA-YSZ	YS	Republic of El Salvador
YVA-YVZ	YV	Venezuela
ZAA-ZAZ	ZA	Albania
ZBA-ZHZ[1]		British colonies and protectorates
ZKA-ZMZ	ZL	New Zealand
	ZK	Cook Islands
	ZM	British Samoa
ZPA-ZPZ	ZP	Paraguay
ZSA-ZUZ	ZS	
	ZT	Union of South Africa
	ZU	

[1] Provisionally assigned by Berne Bureau.

[2] Improperly assigned by Mexico. Should have two letters to distinguish from China.

[3] Unofficial prefix, heritage from I.A.R.U. "intermediates," still used by amateurs in China. They would be better advised to use XG, which would establish nationality.

Amateur Radio Transmitting Activities in N.Z.

THE N.Z. ASSOCIATION OF RADIO TRANSMITTERS

(Contributed by the Headquarters Executive, Wellington.)

Written by C. R. H. TAYLOR, M.A., ZL2DG, and S. H. PERRY, B. Com. ZL2BC., Editors "Break-In."

AMATEUR RADIO: ITS EVOLUTION

WHILE New Zealand has scarcely been so vividly conscious of the romantic evolution of radio communication, such as has slowly won through overseas, notably in the United States, yet its history is a tale that is not lacking in brilliance of achievement, the depicting of devotion to a hobby or the intangible magnetic charm of mystery and wonder.. Since the few odd spark sets, utilising crystal receivers, roared and thundered in broad sonorous drone, their signals over a few miles of country or sea, growth has continued till, with the general acceptance of Continuous Wave from 1923 onwards, the present day finds a fraternity of amateur radio operators whose enthusiasm and ability is second only to the efficiency of their modern transmitting stations, that, with relatively low power, throw their whistling signals around and across the world.

The present-day high efficiency level of our amateur stations is very largely due to the co-operation existing between amateurs all over the country. The older and more experienced fellows have always 'extended a welcome and helping hand to the newcomer, and knowledge and help have been distributed to the advantage of all.

Prominent among such organisations as bring radio people together is the N.Z. Association of Radio Transmitters, with its branches all over the two islands, and its little magazine "Break-In" a common bond that apprises every member of the activities of the parent body and of his fellows.

At the present time the Association embraces practically all the keen amateurs of N.Z., numbering nearly 500. In all the larger towns and cities, clubs or societies are in operation, and regular meetings are held where the fellows congregate to hear lectures, swap experimental experiences, and discuss activities on the air etc. etc.

From time to time social events are organised, generally taking the form of "Hamfests" where the main items are morse contests, musical entertainment, the inevitable liars' competition (generally won by a DX fiend!) and a "rag-chew" over the good beer (ginger) and cheese.

The cameraderie developed from these gatherings, if attended in the right spirit (as they always are) makes of all the chaps in a district one big family, and the fellowship over the air is splendid to join.

Apart from these activities, the Headquarters Executive, situated at Wellington, holds a Convention each year, when representatives from the rest of N.Z. assemble to consider matters of import to Amateur Radio. A system of relaying messages from one part of the land to another is operative, and stations work in conjunction one with another to maintain this service.

A splendid example of this was shown in the recent catastrophe at Napier, when station 2GE formed the only reliable and definite contact with Wellington, where 2GK acted as official Post Office Station. At the same time, station 2BE in Hastings, with a low power outfit, formed the only link from that area, with ZLW, Tinakori Radio Station at Wellington. Furthermore, 2FF in Gisborne handled a great amount of traffic from 2BE, thus adding to the facilities of the Post Office.

This scanty account gives some idea of the usefulness of the work of the N.Z.A.R.T. and shows its value to not only the community but the Government as well.

The objects of the Association are then, briefly, to weld together all Radio amateurs, with a view to improving their mutual knowledge, their status as amateur stations, and their value to the community and to themselves. The medium of this carefully directed effort is the magazine "Break-In," which devotes its columns to developing all these aims in every way.

Hence, for the listener on short waves, who is interested in the technical side even a little, the Association can offer unmatched advantages.

And now, gentlemen, having presented some of the sober facts of the case, I shall vacate the microphone in favour of my colleague, who will elaborate the afore-mentioned facts.

Amateur Radio: Practical Activities

Good evening everyone! N.Z.A.R.T. Headquarters calling. You have read the admirable exposition of the activities of the Association to which all N.Z. amateurs are proud to belong. There is a reason for their pride. N.Z.A.R.T. numbers among its members amateurs who are known throughout the civilised world for their prowess on the air.

N.Z. is perhaps more fortunately situated as regards long distance operating (DX) than any other country in the world. Our nearest neighbour is 1200 miles away, but the amateur mind soars to contacts with North and South America, with the Mother Country, with Europe, North and South Africa, India, China and Japan. Too numerous to mention are the hams in N.Z. who have the coveted "W.A.C." certificate (worked all continents—6 in number). A commercial station uses thousands of watts to establish communication with the other side of the world; the ham is allowed a maximum power of 100 watts. What a contrast and what a testimonial to the perseverance and technical ability of the amateur radio fraternity!

As my most worthy colleague has mentioned—it was amateur radio which established and maintained contact with the stricken area in the Napier upheaval, and it is to "ham" radio that henceforth N.Z. and the world will look in times of emergency. When the mighty emperors of the air—the huge, roaring, blatant commercials—can draw the kilowatts that feed their hungry tubes, they are awful in their might; but when disaster strikes the land and the supplies of electricity from far away can no longer satisfy their almost insatiable demand, then they are pitiful in their impotence. Needs must they then descend to lower power if traffic is still to be handled, and when low-power work is necessary the amateur is on his own ground—sure of his apparatus and certain of his ability.

The Association in New Zealand that embraces the amateurs and their keen listeners-report-stations is known as N.Z.A.R.T., and in future those five magic letters will come ever more often before your notice. N.Z.A.R.T. has been growing steadily for the last few years and has now reached a point where it is necessary to swell its ranks from outside the circle of active transmitters. Keen receiving stations who will listen to amateur transmissions both on phone and key are just as valuable to us as actual transmitters. This movement towards a brotherhood where S-W listeners and amateur transmitters can grasp the hand of friendship has already made its presence felt in Great Britain. There, the Radio Society of Great Britain (R.S.G.B.) has welded the S-W listeners and the transmitters into an effective whole.

Reports from British Official Report Stations (B.R.S—) are regularly being sent to New Zealand to let the ham know what his signals are like 12,000 miles away. These listeners are doing great work and N.Z.A.R.T. will welcome among its ranks any keen S-W listeners in N.Z. who are willing to report on amateur transmissions or who may wish at some future time to go on the air themselves.

The Association has four main districts, several sub-districts controlled from Headquarters in Wellington. Each district holds monthly meetings to maintain the interest of members with talks, lectures, and informative discussions. It is at these meetings that you meet the real hams—the men who really get things done instead of listening while others do them.

The districts are co-ordinated at Wellington, where N.Z.A.R.T. Headquarters is situated. Contact is preserved with District Secretaries and Treasurers so that Headquarters knows immediately a new ham gets through his amateur's exam., and we are then keen to know his call and full address. This system enables us to adopt a policy of centralised effort and control.

The Headquarters Executive is composed of five members who are responsible for administrative, secretarial and treasurer's work. They collect copy, write articles, and publish "Break In." "Break In" is issued monthy by the ham and for the ham, so that its pages are chock full of interesting articles and information. If a S-W listener subscribes to "Break In" he can keep his finger on the pulse of amateur radio in N.Z.

Our members have also the right to wear a distinctive N.Z.A.R.T. badge, to attach official N.Z.A.R.T. stickers to their correspondence and report cards, and to display an N.Z.A.R.T. certificate on the walls of their operating rooms.

The Association, however, realises that the future of N.Z.A.R.T. lies in the keen young member who wishes to put his spare cash into apparatus rather than into subscriptions to an Association. It is to cater for the keen young fellow that N.Z.A.R.T. is keeping its sub. at the low rate of 5/- per annum, which includes post free copies of "Break In" every month and the various other privileges mentioned above.

Now, please take careful note that N.Z.A.R.T. wants keen young members to run its official report stations and that prospective amateurs are specially catered for in the pages of our magazine "Break In."

Well, OM, will Q.R.T. now—cheerio! N.Z.A.R.T. H-Q, Box 489, Wellington, now closing down. We would appreciate reports on this transmission. Good evening everybody.

Amateur Radio Stations of New Zealand

THE complete list of calls reproduced below has been compiled and supplied by N.Z.A.R.T. Headquarters so that listeners may be encouraged to listen to amateur transmissions and to report thereon. If you hear a call that is not listed here or in the supplementary lists that will be printed in "New Zealand Radio," just address the card to N.Z.A.R.T. H-Q., Box 489, Wellington, and it will be forwarded. Any financial member of N.Z.A.R.T. may obtain official QSL cards from the same address at a reasonable cost, and full instructions for filling them in correctly will be given.

FIRST DISTRICT

ZL1AA—C. N. Edwards, 18 Meola Road, Pt. Chevalier, Auckland
ZL1AB—S. G. Waite, 54 Marlborough Street, Dominion Road, Auckland
ZL1AC—C. L. Button, 20 Tainui Road, Devonport, Auckland
ZL1AD—Leys Institute, St. Marys Road, Ponsonby, Auckland
ZL1AE—J. Roberts, 59 Hepburn Street, Ponsonby, Auckland
LZ1AF—G. W. Smithson, 39 Surrey Street, Grey Lynn, Auckland
ZL1AG—F. Roberts, 24 Kimberley Road, Epsom, Auckland
ZL1AH—Hartle & Grey, 7 Alten Street, Auckland
ZL1AI—C. McLean, "Bird Grove", Waipu, Auckland
ZL1AJ—N. C. Shepherd, 1 Norths Road, Whangarei
ZL1AK—W. H. Claxton, Box 43, Thames
ZL1AL—R. G. Bartrum Western Electric, Stratford
ZL1AM—J. C. Isherwood, Jacks Buildings, Vine, Street, Whangarei
ZL1AN—H. B. M. Arthur, 14 Richmond Road, Ponsonby, Auckland
ZL1AO—R. G. White, 9 Veronica Avenue, Mt. Albert, Auckland
ZL1AP—N. J. Winch, Brady Street, Te Awamutu
ZL1AQ—G. R. West, Box 54, Tauranga
ZL1AR—L. M. Mellars, 20 Rangitoto Avenue, Remuera, Auckland
ZL1AS—W. A. Penton, c/o 2YA, Box 637, Wellington
ZL1AT—G. S. Swain, Mahoe Street, Te Awamutu
ZL1AU—C Wight, Puke Road, Paeroa
ZL1AV—F. C. Reardon, 154a Hobson Street, Auckland
ZL1AW—R. R. Lyons, Mangatawhiri Valley, Auckland
ZL1AX—R J. Orbell, 10 Beaconsfield Street, Devonport, Auckland
ZL1AY—N. S. Barnaby, 51 Grange Road, Mt. Eden, Auckland
ZL1AZ—J. R. Sherson, 14 Stanley Street, Claudelands, Hamilton
ZL1BA—R. J. Taylor, 2 Fremont Street, Parnell, Auckland
ZL1BB—R. Beazley, 19 Alexandra Avenue, Mt. Albert Auckland
ZL1BC—W. E. F. Mickelborough, 204 Great North Road, Grey Lynn, Auckland
ZL1BD—W. H. Wadham, 16 Dunkerron Avenue, Epsom, Auckland
ZL1BE—E. K. McKay, 3 Windsor Street, Parnell, Auckland
ZL1BF—A. L. Partelow, 52 Brighton Street., Parnell, Auckland
ZL1BG—Dr. B. G. Thompson, King George V. Hospital, Rotorua
ZL1BH—A. H. Hudson, 15 Mt. Hobson Road, Remuera, Auckland
ZL1BI—J. R. Turnbull, 47 Beresford Street, Bayswater, Auckland
ZL1BJ—R. M. Jackson, Box 5, Onehunga
ZL1BK—A. G. Reid, 5 Marine Terrace, Bayswater, Auckland
ZL1BL—J. S. Lynch, 51 Brandon Street, Frankton Junction
ZL1BM—L. E. A. Corbett, 30 Ardmore Road, Herne Bay, Auckland
ZL1BN—D. W. M. Tapp, Box 7, Rotorua
ZL1BO—G. D. Gerken, Cape Maria Van Dieman, Auckland
ZL1BP—J. D. Surman, 3 Ashton Road, Mt. Eden, Auckland
ZL1BQ—M. W. Coutts, 60a Arney Road, Remuera, Auckland
ZL1BR—L. Ferguson, c/o B. Spitz, Draper, Edendale, Auckland
ZL1BS, R. E. Grainger, 88 Clarence Street, Ponsonby, Auckland
ZL1BT—S. S. Edwards, Box 390, Auckland
ZL1BU—A. D. Anderson, 1 Seddon Terrace, Otahuhu
ZL1BV—A. Evans, Great South Road, Papakura, Auckland
ZL1BW—A. R. Seccombe, 12 Te Aroha Street, Claudelands, Hamilton
ZL1BX—Druleigh Business College, Tasman Buildings, Anzac Avenue, Auckland
ZL1BZ—A. P. Reynolds, Okarea, Waerenga
ZL1CA—H. Jakeman, Progress Buildings, Huntly
ZL1CE—J. Nobes, Goodfellow Street, Te Awamutu
ZL1CC—W. H. Potter, Hora Hora Power Station, Cambridge
ZL1CD—J. Baxendale, 532 Manukau Road, Epsom Auckland
ZL1CE—T. A. Sargent, 34 Bellwood Avenue, Mt. Eden, Auckland
ZL1CF—H. M. McLean, Leith Street, Te Awamutu
ZL1CG—W. Scarborough, 115 Newton Road, Auckland
ZL1CH—H. A. Boyd, 442 Manukau Road, Epsom, Auckland
ZL1CI—C. Wight, Puke Road, Paeroa
ZL1CJ—H. A. Boyd, 18 Hill Street, Newmarket, Auckland
ZL1CK—G. M. Salt, 81 Western Springs, Morningside, Auckland
ZL1CM—A. E. Humphrey, 29 Montrose Street, Pt. Chevalier, Auckland
ZL1CN—E. Blumhardt, 19 Norfolk Street, Whangarei
ZL1CO—J. Bach, 31 Grange Road, Mt. Eden, Auckland
ZL1CP—W. G. Ward, Cameron Road, Tauranga
ZL1FA—White Island Products Ltd., White Island
ZL1FB—G. T. Gulde, Hospital Hill, Opotiki, Auckland
ZL1FC—N. G. Gulde, c/o 4BL, Bellevue, Derwent Street, Oamaru
ZL1FD—F. R. Booth, 28 Rosstrevor Street, Hamilton
ZL1FE—A. F. Wood, P. W. Station, Waihou, Auckland
ZL1FF—L. W. White, 3 Veronica Avenue, Mt. Albert, Auckland
ZL1FG—N. C. Pawley, Cameron Road, Tauranga
ZL1FH—J. Steele, "Linwood" Earnoch Avenue, Takapuna, Auckland
ZL1FI—C. S. Goodwill, Jocelyn Street, Te Puke
ZL1FJ—W. J. Sexton, 14 Ethel Street, Edendale, Auckland
ZL1FK—S. M. Y. Hamlin, Mt. Wellington Highway, Ellerslie, Auckland
ZL1FL—J. Walker, 18 Ewington Avenue, Mt. Eden, Auckland
ZL1FM—J. E. B. Warn, 17 Gorrie Avenue, Epsom, Auckland
ZL1FN—W. A. McDevitt, 42 Mozely Avenue, Devonport, Auckland
ZL1FO—E. R. Cooper, 8 London Street, Ponsonby, Auckland
ZL1FP—G. S. Anchor, Radio House, Hamilton
ZL1FQ—T. Clarkson, 10 Madeira Lane, Auckland
ZL1FR—L. W. Harries, 55 Athens Road, Onehunga, Auckland
ZL1FS—L. R. Dickson, 3 Gorrie Avenue, Epsom, Auckland
ZL1FT—N. N. Walding, 64 Hepburn Street, Ponsonby, Auckland
ZL1FU—G. D. White, Bridge Street, Opotiki
ZL1FV—A. Evans, Wairoa Road, Papakura, Auckland
ZL1FW—E. Whitely, 1 Halston Road, Dominion Road, Auckland
ZL1FX—J. H. L. Trenwith, 19 Bellwood Avenue, Mt. Eden, Auckland
ZL1FY—N. C. Curtis, Whataro, North Wairoa
ZL1FZ—Auckland Grammar School, Mountain Road, Mt. Eden, Auckland
ZL1XI—Auckland University College, Princess Street, Auckland

SECOND DISTRICT

ZL2AA—A. S. Brown, 14 Grant Street, Dannevirke
ZL2AB—D. Wilkinson, Waerenga Road, Otaki
ZL2AC—I. H. O'Meara, Bushmere Road, Gisborne
ZL2AD—P. R. Stevens, 258 Gladstone Road, Gisborne
ZL2AE—R. J. Patty, 55 Salisbury Road, Gisborne
ZL2AF—W. J. Sinclair, Hirini Road, Gisborne
ZL2AG—S. W. S. Strong, 160 Clifford Street, Gisborne
ZL2AJ—V. H. Parminter, 41 Drummond Street, Wellington
ZL2AK—A. McD. Cooper, c/o Western Electric Co., Wellington
ZL2AM—G. F. Buist, Corner Collins and High Streets, Hawera
ZL2AN—M. L. Westow, 47 Barrand Street, Dannevirke
ZL2AP—J. L. Armstrong, Maungataniwha, Wairoa
ZL2AQ—C. K. Branigan, 73 Coutts Street, Kilbirnie
ZL2AR—A. McB. Rennie, 3 Dustin Street, Wanganui
ZL2AS—H. R. Boyle, 46 Wright Street, Wellington
ZL2AT—E. W. Beale, 405 Gray's Road, Hastings
ZL2AV—R. G. Chatfield, 42 Raroa Road, Kelburn
ZL2AW—C. R. Clarke, 85 Apu Crescent, Lyall Bay, Wellington
ZL2AX—J. V. Kyle, 50 Waldegrave Street, Palmerston North
ZL2AY—F. D. Bitossi, 49 Durham Street, Wellington
ZL2AZ—F. E. Duggan, 196 Sydney Street, Wellington
ZL2BA—F. T. Cropp, 17 Mason Street, Lower Hutt, Wellington
ZL2BB—J. A. Lynn, 414 Lyndon Road, Hastings
ZL2BC—S. H. Perry, 89 Tiber Street, Island Bay, Wellington
ZL2BE—J. C. Mills, 311 Queen Street, Hastings
ZL2BF—B. H. Mathews, Ridgeway, Mornington, Wellington

ZL2BG—J. G. Tinney, 74 Kainui Road, Hataitai, Wellington
ZL2BH—W. M. Hall, 46 Tarakaka Street, Ngaio, Wellington
ZL2BI—C. G. Liddell, 45 Puru Crescent, Lyall Bay, Wellington
ZL2BJ—A. V. Jury, Papawai, Greytown
ZL2BL—V. H. Parminter, 45 Hopper Street, Wellington
ZL2BM—W. Griffiths, Box 17, Otaki
ZL2BN—S. J. Hislop, Box 205, Napier
ZL2BO—H. C. Dixon, 36 Devon Street, Wellington
ZL2BP—W. N. Macklin, 75 Waipapa Road, Hataitai, Wellington
ZL2BR—K. A. Lambert, Belmont, Tayforth, Wanganui
ZL2BT—R. A. Tanner, Karere Road, Longburn
ZL2BU—J. F. Donald, 27 Marion Street, Wellington
ZL2BV—F. J. K. Lane, 282 Cook Street, Palmerston North
ZL2BW—J. B. Smith, Harrison Street, Featherston
ZL2BX—R. G. Black, 31 Karepa Street, Brooklyn
ZL2BY—C. T. Berry, 20 Rata Street, Wanganui
ZL2BZ—O. W. Gillion, 17 Wilson Street, Hawera
ZL2CA—W. G. Turnbull, 112 Tinakori Road, Wellington
ZL2CB—F. J. Huggard, Smart Street, Fitzroy, N.P.
ZL2CC—F. R. Beech, Kenepuru Head, Picton
ZL2CD—F. A. McNeill, 14 Pembroke Road, Northland, Wellington
ZL2CE—B. T. Giles, 175 Owen Street, Wellington
ZL2CF—S. Speedy, Pipi Bank, Herbertville
ZL2CG—R. Franklyn, P. B. Bloomfield, Weber, Dannevirke
ZL2CH—M. McKelvie, 174 Oriental Parade, Wellington
ZL2CI—W. A. Wilson, 10 Tawa Street, Muritai, Wellington
ZL2CJ—M. D. Mason, Box 842, Wellington
ZL2CK—W. Macklin, 60 Willis Street, Wellington
ZL2CL—E. Autridge, 89 Fitzgerald Street, Palmerston North
ZL2CM—L. Cannons, 22 Fromont Street, Wanganui
ZL2CN—E. R. Bradley, 85 Alma Road, Wanganui
ZL2CO—A. C. Walker, 80 Rugby Street, Wellington
ZL2CP—J. B. Cormack, 64 Tilley Road, Paekakariki
ZL2CQ—J. R. Trembath, Devon Street, Picton
ZL2CR—R. J. H. Scott, 506E Queen Street, Hastings
ZL2CS—M. J. W. Larking, 88a Wilson Street, Wanganui
ZL2CT—J. Parsons, 26 Harrison Street, Wanganui
ZL2CU—J. A. Murray, 5 Harbour View, Wellington
ZL2CV—E. B. H. Openshaw, Bond Street Ext., Redvales, Marton
ZL2CW—W. H. E. Jensen, 22 Randwick Crescent, Lower Hutt
ZL2CX—G. P. Patchett, 264—Rintoul Street, Wellington
ZL2CY—L. G. Francois, Y.M.C.A., Willis Street, Wellington
ZL2CZ—H. D. Simonsen, Bowford Street, Blenheim
ZL2DA—L. H. Halcrow, c/o 2YA, Wellington
ZL2DB—S. W. Morrison, 27 Monro Street, Seatoun, Wellington
ZL2DC—A. T. Mitchell, 15 Naughton Terrace, Kilbirnie, Wellington
ZL2DD—J. P. Boyer, Aubrey Street, New Plymouth
ZL2DG—C. R. H. Taylor, c/o Library, Agricultural Department, Wellington
ZL2DH—D. L. Bedingfield, Melling, Lower Hutt
ZL2DI—P. R. McMahon, P.O. Box 374, Palmerston North
ZL2DJ—E. A. Petersen, 2 Samoa Street, Kilbirnie
ZL2DK—B. Barclay, 14 Campaign Street, Napier
ZL2DL—R. A. J. Carr, 4 Rua Street, Lyall Bay, Wellington
ZL2DM—C. H. Smith, 558 Childers Road, Gisborne
ZL2DN—S. W. Boon, Box 66, Stratford
ZL2DO—J. L. Fookes, P. W. D., Glenside
ZL2DP—D. P. W. Spackman, 74a Georges Drive, Napier
ZL2DQ—R. N. Kay, Chateau Tongariro, National Park
ZL2DR—I. D. Shearer, Empire Hotel, Rotorua
ZL2DS—K. R. Kirkcaldie, c/o H. Smith, Esq., Waimapu, Bideford, Masterton
ZL2DT—E. C. Johnson, Johnson's Wireless School, Brandon Street, Wellington
ZL2DU—A. Duffield, 49 Ferguson Street, Palmerston North
ZL2DV—N. C. Shepherd, Featherston
ZL2DW—T. Hughes, 21 Ormond Road, Gisborne
ZL2DX—N. C. Fitzgerald, 3 Russell Street, Gisborne
ZL2DY—G. W. Smithson, Seddon Street, Raetihi
ZL2FA—G. B. Butler, 46 Winter Street, Gisborne
ZL2FB—J. W. Bradfield, 19 Berry Street, Gisborne
ZL2FD—H. E. Shelton, 220 Whittaker Street, Gisborne
ZL2FE—J. E. Vautier, 41 Canarvon Street, Gisborne
ZL2FF—C. T. C. Hands, Stout Street, Gisborne
ZL2FG—Hawkes Bay Radio Society, c/o Hawkes Bay Boxing Association Rooms, Hastings
ZL2FH—T. M. S. Fitzgerald, Nolan Street, Hawera
ZL2FI—A. A. Knight, Mana Street, Nelson
ZL2FJ—W. R. Taylor, P. B. Makino, Fielding
ZL2FK—R. A. Tanner, Longburn
ZL2GA—J. Johnson, State Forest Service, Waipoua, via Dargaville
ZL2GC—A. Howarth, 12 High Street, Dannevirke
ZL2GD—B. R. Adair, Box 87, Gisborne
ZL2GE—G. E. Tyler, 61 Vigor Brown Street, Napier
ZL2GF—J. O. Taylor, 248 The Terrace, Wellington
ZL2GG—C. H. Brown, 70 Wallace Street, Wellington
ZL2GH—N. Hopper, 39 Dublin Street, Wanganui
ZL2GI—E. L. MacGregor, "Auaroa", Otane, Hawkes Bay
ZL2GJ—K. L. Elliott, Box 842, Wellington
ZL2GK—S. R. Perkin, 42 Puru Crescent, Lyall Bay, Wellington
ZL2GL—M. T. Gabriel, 80 Grey Street, Palmerston North
ZL2GM—G. T. King, 80 The Parade, Island Bay, Wellington
ZL2GN—E. N. Humphrey, Bartholomew Road, Levin
ZL2GP—W. G. Ashbridge, 40 Sussex Street, Wellington
ZL2GQ—F. I. R. Hunt, 221 Clifford Street, Gisborne
ZL2GR—W. S. Green, 13 Washington Avenue, Brooklyn, Wellington
ZL2GS—H. E. H. Green, Clifford Street, Johnsonville
ZL2GT—R. K. Duncan, 6 Mount Street, Wellington
ZL2GV—A. R. C. Claridge, Box 31 Dannevirke
ZL2GW—S. G. Taylor, Box 17, Levin
ZL2GX—P. A. Tipping, 80 Hataitai Road, Wellington
ZL2GY—L. H. Wass, 11 Queen Street, Petone
ZL2GZ—E. A. McConnell, 551 Childers Road, Gisborne
ZL2XA—E. A. Shrimpton, 38 Rongotai Terrace, Wellington
ZL2XC—T. Mathewson, c/o ZLCI, Chatham Islands
ZL2XE—L. H. Steel, Farm Road, Northland, Wellington
ZL2XG—E. H. R. Green, 14 Moana Road, Kelburn Wellington
ZL2XH—C. P. Hill, 115 Creswick Terrace, Northland, Wellington
ZL2XI—G. W. Marston, Creswick Terrace, Northland, Wellington
ZL2XJ—J. H. Hampton, Upper Orangi Kapapa Road, Wellington
ZL2XK—H. C. C. McCabe, 42 Adams Terrace, Wellington
ZL2XL—L. J. Elliston, Chatham Islands
ZL2XM—W. Marsh, Mills Road, Melling
ZL2XN—Mr. Cassey, 69 Hawker Street, Wellington
ZL2XP—W. M. Dawson, c/o Philips Lamps, Hope Gibbons Buildings, Wellington
ZL2XS—Standard Telephones, Balance Street, Wellington
ZL2XW—W. F. C. Whiteman, 7 Moana Avenue, Lower Hutt, Wellington

THIRD DISTRICT

ZL3AA—W. S. Purton, Waiuta, West Coast
ZL3AB—L. C. Evans, 204 Salisbury Street, Christchurch
ZL3AC—Radio Society of Christchurch, 198a St. Asaph Street, Christchurch
ZL3AD—C. J. Banwell, 9 Chelsea Street, Linwood, Christchurch
ZL3AE—R. K. Venables, 163 Moorhouse Avenue, Christchurch
ZL3AF—G. G. Sandford, Moncks Spur, Redcliffs, Christchurch
ZL3AG—Mrs. Earland, Packers Quay, Greymouth
ZL3AH—H. B. Courtis, 69 Grey Road, Timaru
ZL3AI—J. E. Strachan, High School, Rangiora
ZL3AJ—R. G. F. Blake, Station Road, Southbrook
ZL3AK—S. W. Lane, 19 Bridlepath Road, Lyttelton
ZL3AL—G. C. Beattie, 66 Ashley Street, Rangiora
ZL3AN—S. S. Edwards, 26 Patten Street, Avonside, Christchurch
ZL3AO—G. Hayman, 141 Tainui Street, Greymouth
ZL3AP—C. Tomlinson, Springlea, P. B., Christchurch
ZL3AQ—V. P. Lovett, 130 Alford Forest Road, Ashburton
ZL3AR—D. W. Buchanan, 74 Wills Street, Ashburton
ZL3AS—N. W. Laugeson, 47 Stapletons Road, Christchurch
ZL3AT—L. J. Marquet 30 Chichester Street, Woolston, Christchurch
ZL3AU—H. O. Hills, c/o Gibbs Radio House, Taum Street, Christchurch
ZL3AV—S. P. Wills, 43 Papanui Road, Christchurch
ZL3AW—R. W. Mintrom, Fire Brigade Station, Woolston, Christchurch
ZL3AX—F. P. Earland, Packers Quay, Greymouth
ZL3AY—R. S. Smith, c/o Direct Supply Co., 86 Cashel Street, Christchurch
ZL3AZ—R. J. Gibbs, 180 Rolleston Street, Linwood, Christchurch
ZL3BA—E. B. Buckhouse, Jnr., 98 Office Road, St. Albans, Christchurch,
ZL3BB—W. F. Smith, 28 Derby Street, St. Albans, Christchurch
ZL3BC—J. Harrison, Pinaki P.B., Christchurch
ZL3BD—C. E. Holmes, 65 Slater Street, Richmond, Christchurch
ZL3BE—Boys High School, Christchurch
ZL3BF—E. Prince, c/o R.S.C. 198a St. Asaph Street, Christchurch

ZL3BG—L. W. Hurrell, 204 Salisbury Street, Christchurch
ZL3BH—J. F. Gabites, 445 Marshland Road, Christchurch
ZL3BI—E. S. Borthwick, Commercial Hotel, Kaikoura
ZL3BJ—L. C. Hunter, 62 Colombo Street, Christchurch
ZL3BK—D. D. Innes, Main Road, Springfield
ZL3BL—T. F. Cullman, 72 Bishop Street, Christchurch
ZL3CA—C. A. Hughes, 106 Wildberry Street, Christchurch
ZL3CB—C. R. H. Taylor, Rutland Street, St. Albans, Christchurch
ZL3CC—J. B. Elliott, 25 Frankleigh Street, Spreydon, Christchurch
ZL3CD—G. H. S. Clarkson, c/o N.Z.R., Tinwald
ZL3CE—B. G. Henderson, 100 Rugby Street, Christchurch
ZL3CF—A. E. H. Simpson, 99 Abberley Road, St. Albans, Christchurch
ZL3CG—H. P. V. Brown, 10 Merivale Lane, Christchurch
ZL3CH—H. B. Dixey, 73 Bishop Street, Christchurch
ZL3CI—J. C. Yoeman, 311 Gloucester Street, Christchurch
ZL3CJ—A. E. S. Hanan, 32 Beverley Road, Timaru
ZL3CK—E. G. Shipley, 2 Puriri Street, Riccarton Street, Christchurch
ZL3CL—L. Gerity, 20 Fitzgerald Street, Christchurch
ZL3CM—W. T. Toon, 73 Canon Street, St. Albans, Christchurch
ZL3CN—I. A. B. More, 48 Hackthorne Road, Christchurch
ZL3CO—G. Seton-Kellaway, Box 1, Waikari, Canterbury
ZL3CP—C. W. Parton, 69 Hackthorne Road, Christchurch
ZL3CR—C. R. Hervey, 30 Peterborough Street, Christchurch
ZL3CS—J. Hill, 178 Church Street, West, Timaru
ZL3CT—R. J. Tabley, 113 Milton Street, Speydon, Christchurch
ZL3CU—G. E. McCurdy, 66 Wills Street, Ashburton
ZL3CV—R. W. Saunderson, 223 Cameron Street, Ashburton
ZL3CW—Greymouth Radio Society, 5 Cowper Street, Greymouth
ZL3CX—J. D. Stewart, 112 Alford Forest Road, Ashburton
ZL3CY—W. Hughes, 3 Faraday Street, Sydenham, Christchurch
ZL3CZ—D. V. B. P. White, 27 St. Martins Road, Christchurch
ZL3XA—T. Gates, 2 St. James Street, Linwood
ZL3XB—J. Bingham, 17 College Avenue, Papanui, Christchurch

FOURTH DISTRICT

ZL4AA—F. D. Bell, Shag Valley Station, Waihemo
ZL4AC—R. E. Robinson, 3 Chatham Avenue, Dunedin
ZL4AD—A. E. Jordan, 41 Venus Street, Invercargill
ZL4AE—G. E. Brown, 32 Ardwick Street, Gore
ZL4AI—G. G. Samson, c/o Rolleston House, Christchurch
ZL4AJ—J. Jack, 11 Short Street, Invercargill
ZL4AL—A. H. M. Grubb, 32 Ardwick Street, Gore
ZL4AM—W. Crockett, Tiverton Street, Palmerston South
ZL4AO—H. N. Shrimpton, 17 Coney Hill Road, Dunedin
ZL4AP—L. R. Stroud, Box 46, Dunedin
ZL4AQ—G. T. Edgar, 24 Pine Hill Road, Dunedin
ZL4AR—W. G. Wilkinson, 21 Melrose Street, Dunedin
ZL4AT—J. Stone, 34 Grove Street, Dunedin
ZL4AV—J. L. Milnes, 9 Warden Street, Dunedin
ZL4AZ—T. K. S. Sidey, 11 Corstorphine Road, Caversham, Dunedin
ZL4BA—J. G. Smith, 7 Crosby Street, Dunedin
ZL4BB—J. R. Brooks, 19 Princes Street, Musselburgh, Dunedin
ZL4BC—L. C. Bates, 506 Georges Street, Dunedin
ZL4BD—A. Swann, 33 Barclay Street, Dunedin
ZL4BE—W. H. Shepherd, 31 Warden Street, Dunedin
ZL4BF—G. Borthwick, 8 Arney Street, Dunedin
ZL4BG—W. C. Baird, 6 Young Street, Dunedin
BL4BI—S. R. Hitchcock, Box 289, Dunedin
ZL4BJ—E. P. Cameron, 40 Cargill Street, Dunedin
ZL4BL—Mrs. N. K. M. Kennedy, Derwent Street, Oamaru
ZL4BM—V. G. Whiteman, Puysegur Point Light House, Dunedin
ZL4BN—H. G. Bremner, c/o W.E.C., Hope Gibbons Buildings, Wellington (portable)
ZL4BO—W. V. Macauley, 122 Harbour Terrace, Dunedin
ZL4BP—W. G. Collett, 30 Calder Avenue, N.E. Valley, Dunedin
ZL4BQ—F. E. Frame, 17 Park Terrace, Dunedin
ZL4BK—J. W. Booker, 41 Argyle Street, Dunedin
ZL4BR—S. Dickson, 31 Highgate, Roslyn, Dunedin
ZL4BS—J. A. Sparrow, 24 Oban Street, Roslyn, Dunedin
ZL4BT—J. C. Callender, 124 Richardson Street, St. Kilda, Dunedin
ZL4BU—R. W. Cook, 61 Shetland Street, Roslyn, Dunedin
ZL4BV—J. R. McConnell, 149 Surrey Street, Dunedin
ZL4BW—R. E. Dawson, 29 Tyne Street, Dunedin
ZL4BX—E. R. Pettitt, High School, Methven
ZL4BZ—D. Masterton, 30 Brighton Street, Kaikorai, Dunedin
ZL4CA—A. R. Harris, 52 Peter Street, Caversham, Dunedin
ZL4CB—S. L. Johnson, 34 Esther Crescent, Kew, Dunedin
ZL4CC—L. H. Frapwell, 103 Eglington Road, Dunedin
ZL4CD—F. A. Sims, 169 Andersons Bay Road, Dunedin
ZL4CF—A. D. McLaren, 32 Melbourne Street, Dunedin
ZL4XC—F. J. O'Grady, 4 Hart Street, Roslyn, Dunedin
ZL4XD—Otago Branch, N.Z.A.R.T., 3 Stafford Street, Dunedin
ZL4XO—Dr. Jack, University of Otago, Dunedin

Remarkably Low Prices

ONE often wonders how it is possible to import a radio receiver from practically the other side of the globe, pay a heavy rate of duty and sell at the low price at which it is available. Let us take as an instance the Clarion Receiver, product of the Transformer Corporation of America.

Three years ago this large organisation specialised in the manufacture of power transformers and several other kinds of apparatus which went into the construction of a radio receiver. Large American manufacturers of radio receivers contracted with this organisation for the supply of so many hundred thousand of this or that part with the result that the specialised production of the main pieces of apparatus in a radio receiver enabled a standard of efficiency and production to be achieved which could only be secured by specialisation. However, manufacturers who had hitherto hesitated themselves to produce these intricate parts of a radio receiver decided that they would endeavour to produce their own apparatus. It can be quite imagined how this affected such a large organisation specialising in this class of product.

Being actually in the controlling position of manufacturing the most complicated and intricate apparatus to go into a radio receiver, it was a very simple matter to add the additional components required and acquire a cabinet factory to control the construction of every piece of apparatus that went into a radio receiver.

Being already licensed under all the leading radio patents in the world and being already specialists in construction work, the T.C.A. found it a simple matter to produce a receiver at very much under the cost of other manufacturers. Although having designed and engineered their Clarion Receiver to a stage of perfection and reliability enjoyed by very few other manufacturers they were able to make a price which startled those in the industry. The secret is organised production of everything under one roof and providing only one profit.

The prospective buyer of a radio receiver would profit by the examination of a Clarion Receiver, because although he may pay more, he cannot buy better. The manufacturers show their confidence by merely asking the prospective buyer to look over the Clarion, and hear it perform, and then decide if their slogan, "The Greatest Radio Value at Any Price" does not accurately describe their product.

The *New* *ULTIMATE*

£56

Complete with Valves
and Shortwave Coils
ready to attach to Aerial

The most Revolutionary Advance in Radio Construction yet seen in New Zealand.

Have you seen or heard of another receiver which will give this performance and value?

RECEIVE ALL THE USUAL BROADCAST STATIONS.

RECEIVE THE SHORTWAVE STATIONS OF THE WORLD.

GIVE PERFECT GRAMAPHONE REPRODUCTION WITH PICKUP AND SUFFICIENT VOLUME FOR A DANCE HALL.

OPERATE WITH HOME TALKIES OR TELEVISION EQUIPMENT.

ADJUSTABLE TONE TO SUIT EACH INDIVIDUAL TASTE.

Reproduction through the latest magnificent Jensen full-sized dynamic speaker-the speaker that reproduces a nation's entertainment. Beautiful cabinet which will adorn the most elaborately furnished room.

Don't miss the best part of Radio entertainment. Searching the ether for new Shortwave Stations! It's the most fascinating occupation that can be imagined.
Anywhere—every hour of every day—right round the clock.

There is only one receiver that will give you this performance:—

ULTIMATE

No other receiver that held a proud position of leadership during 1930 can claim

ULTIMATE'S 200% IMPROVEMENT

in it's latest model. A revolutionary advance.

The designers and engineers responsible for the creation of of the new ULTIMATE have *achieved now* what radio scientists have stated is a goal for the distant future.

Listen in on a New Ultimate and double your scope of entertainment, hear

RUSSIA HOLLAND INDO-CHINA
AMERICA LONDON GERMANY
AUSTRALIA ITALY

and dozens of other Stations. They are all yours on the new ULTIMATE

All-Electric, Screened Grid, Pushpull, super power Shortwave, Broadcast, Electric Gramophone, latest Jensen Dynamic Speaker, adapted for Television and Home Talkies — and

BRITISH CONSTRUCTION

ULTIMATE—*the Ultimate in Radio*

A running description of the famous Cricket Match between the Australian and English Teams, was published by a leading newspaper from actual reception received direct on an ULTIMATE by a private owner.

The report of the King's Speech at the Indian Conference, published by one of New Zealand's largest newspapers, was from direct reception by an ULTIMATE in the Home of a private owner. You cannot get this reception on an ordinary receiver.

Distributed by New Zealand's largest and most experienced Music and Radio Establishments also backed by the Dominion's largest and oldest Radio organisation; that's your guarantee of satisfaction.

See the nearest ULTIMATE Distributor, there is one in every district, or write for particulars to Box 1778, Auckland.

Adding a Gramophone Pick-up

THE general method of adding a pick-up to a receiving set is to apply the output from it to the grid of the detector valve which then acts as the first audio amplifier. This is easily accomplished in a battery set in the manner shown in Fig. 1. A low capacity two way switch S.W. is incorporated so that it is as near the grid terminal of the valve socket as possible and the pick-up connected as shown, a biassing battery G.B. being required. The voltage of the battery is determined by the valve being used as detector and the voltage applied to its plate. Its value will be found by reference to the figures suppied by the valve manufacturer.

With an A.C. set the arrangement shown in Fig. 2 may be used. A suitable switch is again required to change from radio reception to gramophone reproduction. The grid return lead from the tuning inductance is taken to the cathode of the valve and to the electrical centre of the filament at the junction of the two fixed condensers, each of .001 mfd, connected across the filament. The biassing of the cathode is obtained through a resistance R_1 by-passed by a fixed condenser of capacity 2 mfds. The size of the resistance is calculated in the manner described for our low power amplifier.

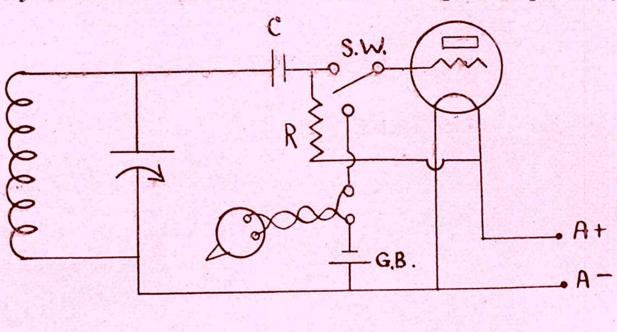


Fig. I

Adding a gramophone pick-up to a battery set

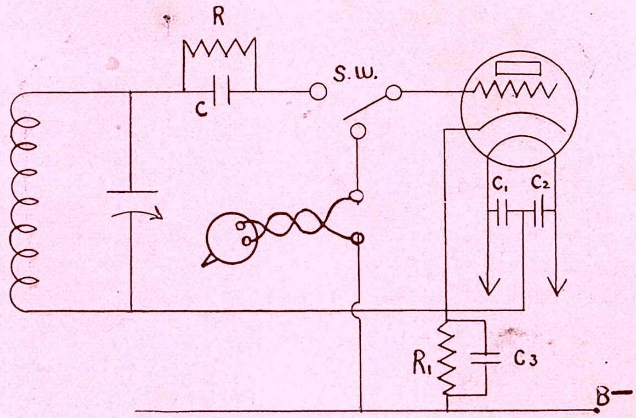


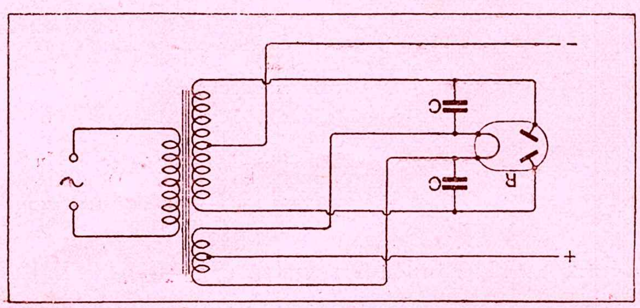
Fig. 2

Adding a gramophone pick-up to an A.C Set

Hum in A.C. Receivers

HUM in an A.C. all-mains receiver may sometimes arise through the generation of radio-frequency currents in the rectifer valve of the power pack. Smoothing arrangements for plate voltages are usually constructed on the basis that only audio-frequency currents are to be eliminated, but this is only partly correct. Radio-frequency currents generated by the power rectifier may be very serious in their effects, for they are modulated at audio fequencies and, it seems, they may be radiated and picked up by the detector valve of the receiver where they are rectified and amplified, the resulting hum being further amplified in subsequent changes of the receiver.

The trouble may be overcome by connecting small condensers (.01 mfds.) between the plates and filament of the rectifier valve as shown in the accompanying figure; this effectively isolates the r.f. currents from the receiver.



Drilling Mica

AMATEURS sometimes find it necessary to take upon themselves the task of making their own fixed condensers for special purposes, and, in such cases, trouble is very frequently experienced in drilling a clean hole through the mica dielectric sheets, especially near the corners or edges of the mica.

The difficulty is, of course, that mica is brittle and thus it tends to chip away when drilled.

An easy way out of the difficulty, however, consists in sandwiching the mica sheet between two perfectly flat pieces of wood which are then clamped in a vice, or held together tightly by some other means.

Truth, as interpreted through the medium of Art, that commercial imbecility at its most nervous tension could conceive."

The commercialization of the kinema has resulted in the debasing of an art which, properly handled, could even now bestow great and lasting benefits on mankind, and has also resulted in few improvements being adopted which did not assure the kinema corporations increased profits. The progress of the kinema, therefore, has taken place solely insofar as was required to attract a sensation-loving mob for the purpose of enriching the commercial concerns exploiting the kinematograph, and much that might have been done towards perfecting the kinematograph has been left undone, because the adoption of some of the greatest improvements would not have meant increased profits to the exploiters.

It is hoped that similar circumstances will not arise in respect of television, if they do the progress of television is certain to be retarded as the progress of the kinema has been retarded.

THE NEED OF TELEVISION

The public's need of television is already great, but it is rapidly becoming greater. The public in general is growing tired of the "fake" to which the kinematograph so readily lends itself. The public is manifesting a growing desire to see things and people as they are, and not as the kinema directors "fake" them to appear. There is always a feeling in the public mind nowadays that the people the kinematograph purports to cast in shadow are not the real people, but are others who are impersonating the originals, and there is adequate reason for this doubt. The public is also desirous to see events as they happen, not some time after they have happened and have been "faked" by kinematograph directors to suit vested interests. By means of a practical system of television the public would be provided with a view of the events precisely as and when they happen, and would have the satisfaction of knowing that nothing had been added or deleted.

There is also a growing desire on the part of the public to see the real people rather than to gaze at their shadows cast upon a screen, as witness the following passage taken from Arnold Bennett's "Journal 1929," p.p. 123-126, and dated London, September, 1929.

"I went by invitation to the "world-premiere" of an English-written and English-directed talking film, in which Gloria Swanson was the star. The film was apparently made in America. . . . A gentleman came in front of the curtain and said, inter alia: 'Miss Gloria Swanson is in the audience and if you will kindly remain in your seats for one minute after the conclusion of the new film, you will see her.' At these words there was a great noise from the audience—a curious kind of clapping not intended to signify approval. The talking film began. The noise increased. So much so that the film, although it could be seen, could not be heard at all. The film-operator and the audience were equally obstinate for a minute or two. The audience won. Gloria Swanson, who was seated a few rows behind me, stood up in the gangway and bowed. Useless! Half the audience could not see her. The audience grew still more restive. . . .

"She left the circle, and was presently seen walking up the central aisle of the floor, well escorted. Then she came before the curtain, obviously in a highly nervous condition, and made a little speech, which was almost inaudible. As soon as she retired, at least two-thirds of the huge audience on the floor stood up and hurried from the theatre. They had come to see, not the film, but Gloria Swanson. . . .

"The film started again, to many hundreds of empty seats. . . . Crude, tawdry, grossly sentimental, encumbered with stretches of acutely tedious and undramatic dialogue, and rendered ugly by the continuous falsification of the sound of the human voice, which mars all talking films. . . .

"I left the theatre saddened by this spectacle of the waste of a first-rate artiste. . . ."

This may be taken as an absolutely unbiassed criticism, coming as it does from a celebrated playwright who is engaged in writing plays both for the legitimate stage and the picture screen.

Of course, there are many millions of us who cannot see all the people and places we wish to see, neither can we be on the spot to witness important events as they are happening. The next best thing is to have the reflections of these sent out to us; and there is no doubt that, worked by an efficient method, television could satisfy our requirements much more nearly than they will ever be satisfied by the kinematograph, especially while the latter remains largely under the control of the sensation-mongers and the "fake"-mongers.

There is a very wide scope for television, and it is a science which can confer enormous benefits on mankind if it is properly handled; especially can it be beneficial to all who, like ourselves, are so far removed from the centre of the Empire and from the centres of the more important foreign countries. Illustrations of events of world-wide interest require weeks to reach us under present-day conditions, and many of them do not reach us until they have passed into history; but effective television can remove this disadvantage. It must be borne in mind, however, that the television we require is an effective form of transmission, and we must not accept any makeshift which commercial concerns may try to foist on us in lieu of the real thing.

PROGRESS OF TELEVISION

DURING the past year little mention of the progress of television has been made in the New Zealand daily and weekly papers, and the information which has been given from time to time has been dealt out in small scraps dealing with particular experiments rather than with the science as a whole. From this it must not be inferred that little or no progress has been made in television throughout a whole year: considerable progress has, indeed, been made; but little of this has been of practical value, in spite of the large value it has from the laboratory point of view.

The two main mtehods of transmitting pictures at present in use have been subjected to severe tests: Baird, in Great Britain, has been persevering with the disc, while, in U.S.A., Jenkins has been assiduously occupied with the drum. Both have met with more or less success, and many broadcasts have been carried out. Public demonstrations have also been given on the picture screens, but, on the whole these have been far from satisfactory, and there remains much to be done before the approval of the tions can be expected to gain the approval of the general public. Even now these presentations are remarkably crude, in spite of the many improvements which have been made. Most of these improvements have been very minor affairs, but essential nonetheless to satisfactory transmission, although many of them would appear absolutely meaningless to the general public.

Much discussion has taken place during the year regarding the must suitable shape of the holes through which the light is to be cast. Round, oval, square, and diamond shaped holes have been tested, and it is generally considered that the best results are obtained by the use of the last named. Whichever shape is used, however, the resulting picture is made up of thousands of small dots, somewhat similar to the half-tone pictures which will be found in number in these pages; but the television picture is not produced all at once in the same manner as is the half-tone used for magazine and newspaper illustration. The television picture is built up piecemeal, but with such rapidity that the whole of the picture becomes visible to the human eye at one time instead of being presented in the sections in which it is produced; the rapidity of production enabling the last section produced to become visible before the first fades, thus giving the illusion of a completed picture every portion of which has been thrown on the screen simultaneously.

It will be seen that this method of picture production presents enormous difficulties, and that the size of the picture is necessarily greatly restricted in order that the whole may be made visible at one time. This means that it is not yet possible to portray by means of television a large crowd, or a scene which is spread over a large area, and, in a general way, the presentation of portraits is restricted to the portrayal of head and shoulders, thus giving little scope for demonstration.

It is obvious from this that a satisfactory means of making television pictures has not yet been discovered, and the experiments which have been carried out during the past year have served to prove this fact if they have done nothing more. Something, therefore, has been accomplished, and it still appears that television will be of no value for commercial purposes or even for the "looker in" until a method has been discovered whereby television pictures may be produced in the manner in which Nature flings up a mirage. Even when this method is discovered and put into use a difficulty will arise at the receiving end in many cases: the home of the average "looker in" will not be large enough to allow him to use a screen or a box sufficiently large in order to take the picture at a size which will display clearly the essential details.

SPEED OF TELEVISION PROGRESS

It is contended by some that the progress which is being made in television is remarkably slow; but when television is compared with the kinema it will be seen that this statement contains little or no truth. The moving pictures we see to-day are almost as crude as those which were shown to us some thirty-five years ago when the kinematograph was first introduced to the public. Certain advances have admittedly been made, and chief amongst these is production in natural colours which was possible twenty or more years ago, but which has been used very little on account of the extra cost entailed in producing in natural colours instead of the drab black and white pictures which are still the variety principally shown. Even after a lapse of some thirty-five years efficient stereoscopic presentation of kinematographic pictures has not been made possible, therefore the progress of television cannot be deemed to be slower, if as slow, as that of the kinematograph.

Undoubtedly the progress of the kinematograph has been retarded to a very large extent on account of its having fallen into the hands of the sensation-mongers for exploitation, instead of being dealt with by the artists. Thus the majority of the moving pictures seen on the screen to-day are produced with the object of exciting the beholder rather than for the portrayal of beauty. The result has been aptly described by W. J. Locke in his novel "The Old Bridge," where, in dealing with the kinema, he states: "There was every flatulent negation of

SHORT WAVE STATIONS

LISTENING TO THE BEST ADVANTAGE

FOR those to whom there is a fascination in listening at good loudspeaker strength to programmes from distant countries, to special broadcasts from London, or to nightly experimental transmissions between duplex telephony stations in Europe and other countries, as well as between amateurs, some knowledge of when to listen, and how to get best results, is of decided advantage. Tuning in short wave stations is a very simple matter almost as simple as receiving long wave stations, once a few simple details are understood.

Time Difference

Firstly, it should be understood that in the distant country where the transmission is being conducted, the time of day as a rule is quite different to that in New Zealand. For instance, New Zealand Standard time is 19½ hours ahead of San Francisco time. That is to say, if Standard Time in New Zealand is 6 p.m. on a Sunday evening, then the time in San Francisco is 10.30 p.m. of the previous Saturday evening. In New York the corresponding time is three hours later, or 1.30 a.m. on the Sunday morning.

The result of this time difference is that most short wave stations in the United States have closed down before 6 p.m. New Zealand time, or if they have not closed down by that time, they will do so shortly afterwards. Therefore, except in cases where special late transmissions are being conducted, the best time to listen for United States short wave stations is between about 4.30 p.m. and 6.30 p.m. New Zealand time. Time chart on page 52 will be useful when tuning for foreign stations.)

How Daylight Affects Reception

Unlike long waves short waves are capable of travelling great distances in daylight. The shorter the wave length the more does this become true. Thus wavelengths of about 80 metres will provide good reception all over New Zealand in broad daylight, when long waves are unsatisfactory. Except when very high power is used, however, the limit of the daylight range for 80 metres is about 800 miles. On the other hand, wavelengths in the neighbourhood of 40 metres have an average daylight range of from 3000 to 4000 miles, whereas wavelengths below this value have a correspondingly greater range by day. This fact is noticeable when listening for United States short wave stations in the late afternoon. The first stations picked up are those operating on the lower wave bands, about 30 metres or below. Those operating on about 50 metres do not start to come through with great strength till evening approaches. The reason for this is that during our afternoon in New Zealand the twilight band is sweeping gradually across the Pacific Ocean, so that the amount of darkness between New Zealand and the United States increases also till finally there is darkness all the way between ourselves and the United States. As a matter of interest, it has been ascertained in recent years that wavelengths below 10 metres will not travel more than a few miles in darkness, although when there is daylight at both ends the range is often thousands of miles. The use of these very short waves, however, has several disadvantages for purposes of broadcasting, which as yet have not been surmounted.

Seasonal Effects

Although, generally speaking, the change of season affects short wave reception only in as much as it constitutes a change of the daylight conditions, there are several points in connection with seasonal effects which should prove of interest to set owners.

For instance, the best time of day for short wave reception from Europe changes very markedly with the season. During the winter months, from March till August or September, station G5SW in England may be heard in New Zealand strongly during the daylight hours, from about 6am till noon, but about midnight reception from this station is unsatisfactory. On the other hand, during the Summer, reception is unsatisfactory in hours of daylight, but the station is heard well at midnight, reception conditions being entirely reversed. This fact refers not only to station G5SW but also to other European stations. The reason for this seasonal effect may be understood by referring to a globe of the world. During New Zealand's Winter the earth is tilted at an angle with respect to the sun, such that the shortest path in greatest darkness between England and New Zealand occurs during our daylight on a Great Circle running South from England. During our Summer however, it will be seen by referring to the globe that the shortest path in greatest darkness is during our night on a Great Circle running North from England. As short waves prefer darkness, although travelling in daylight also, the best times as regards day and night for reception from England and Europe are as stated above. Reception from England and Europe during twilight hours generally is at a peak, independent of the season, for then darkness covers almost the entire distance for a short period.

When to Listen for Different Countries

The following details of the best times to listen for various short wave stations in different countries, together with any known particulars of wavelengths and schedules, are intended as a guide for

use when searching for stations. As various stations alter their shedules and wavelengths from time to time, these as given do not necessarily hold good indefinitely, but are subject to modification. However the particulars supplied here are correct as far as is known at the present time.

Early Mornings:—From about 5 a.m. till 7 a.m. in the Winter time, during hours of twilight, European stations are heard at their maximum strength. From about 5 a.m. to 6 a.m. station PCJ in Holland has been conducting transmissions on alternate days. The exact times are indefinite. G5SW in the Winter time is heard to start up at 6.30 a.m. relaying the normal London programme broadcast through 2LO. Generally the strength, which is excellent, is maintained till well into the morning. G5SW closes down with the chimes of Big Ben striking midnight at 11.30 a.m. N.Z. time. As mentioned under the heading "Seasonal Effects," reception from European stations after dawn in the Summer time generally is less reliable than in the Winter. Other stations which are heard during the early morning are Zeesen, Germany, and 3RO Rome, Italy. Rome is received with considerable strength even on Summer mornings. Beam telephony stations in various countries should be heard at this time.

N.B.—G5SW does not transmit on either Sunday or Monday mornings.

Later Mornings:—From 7 a.m. till midday there are few foreign stations to receive in the Summer time, although, as mentioned above, G5SW may be heard in the Winter time till 11.30 a.m., except on Sundays and Mondays. During week-ends especially there are numerous New Zealand experimental amateur stations on the air on 80 metres.

Early Afternoons:—From midday till about 3 p.m. there are not many stations on the air except amateurs on 80 metres. However, some of the United States stations on the lower wavelengths may be heard before three o'clock under good conditions. Frequently, also, a station at Buenos Ayres is heard at considerable strength before 3 o'clock.

Late Afternoons:—From 3 p.m. till 7 p.m. is the best period for receiving American stations. KDKA Pittsburgh, W2XAF Schenectady (New York), and several others on the shorter wavelengths gradually increase in strength till they close down about 4 p.m. or 4.30 p.m. From about 4.30 p.m. W3XAL Schenectady, WENR (9XF Chicago) on somewhat longer short waves, start to increase in volume, till they close down about 5.30 or 6 p.m., when their volume generally is excellent. On Saturday afternoons in the Winter time station PCJ in Holland is heard clearly from 3 p.m. till about 6.30 p.m. broadcasting a special programme to Australian and New Zealand listeners. Beam telephony stations frequently are on the air during this period.

Early Evenings:—From 7 p.m. till 10 p.m. especially on Sunday evenings (Saturday evening in U.S.A.) several United States stations which are running later than usual are heard. At 7.30 p.m. approximately a Siberian station comes on the air with talks in Russian, and musical items, and continues till about midnight. During the evening duplex conversations are conducted between Sydney, London and Wellington on the beam system. These are received at great strength. At about 11 p.m. or 11.30 p.m. a station at Saigon (French Indo-China) comes on with musical items. Sometimes the announcing is in French, and sometimes in Chinese. The volume from this station is very great. New Zealand and Australian amateur stations are on the air during most of the evening conducting experiments with music and telephony.

Late Evenings:—At 12.30 a.m. New Zealand Summer time during the Summer months G5SW (Chelmsford, England) comes on the air till 1.30 a.m. with musical entertainment **except Sunday and Monday mornings.** Exactly at 1 a.m. seven time ticks are superimposed on the music. These are direct from the Greenwich Observatory. There is one second between the successive ticks. As Winter approaches, this schedule becomes weaker. (See under heading "Seasonal Effects.") About this time of the morning several other stations generally are heard operating also till early morning.

The above list gives a few only of the world's principal short wave stations which can be heard. With a little patience, many more such stations can be picked up and identified.

Tuning Frame-Aerials

WHEN a frame is required to cover both medium and long-wave stations, the total number of windings is usually made sufficient to cover the long-wave programme, and a switch is provided for cutting out the unnecessary turns when changing-over. The same effect can be secured by separating the windings into two sections, and switching these into series connection for long-wave work and into parallel for the medium-wave stations.

If it should be found necessary to use a loading coil, this should be inserted at the centre-point of the existing frame windings rather than at either end. The grid lead to the first valve should then be tapped off from the centre point of the added coil.

SHORT WAVE FASCINATION

Shortwave radio reception has opened another door for the true radio enthusiast in the field of entertainment, education and experiment. It has given a new lease of life to the "distance hound" and for those to whom radio reception has become more or less commonplace, it is providing a distinctly original thrill.

Tuning in shortwave stations is similar to, yet decidedly different from, tuning in longwave stations. The physical principle is identical, but shortwave tuning requires a little more care. The reward of shortwave reception is infinitely greater when the stations do come in. To get foreign countries in your home, direct, certainly provides a much keener thrill than merely spanning a few stations.

Shortwave is not as susceptible to static and interference as longwave, and one shortwave frequency band may be entirely free from interference and static, but distance reception may be impossible on the other band of frequencies. Thus shortwave reception may be obtained even when reception conditions are at their worst.

Only those who have listened in on a thoroughly efficient shortwave receiver can possibly realize the marvels of shortwave telephony.

The fascination of listening in on shortwave stations from every part of the Globe cannot be realized until one has handled a really efficient, powerful, shortwave receiver.

Occasionally the average owner of a broadcast receiver picks up Australian or Japanese stations which reception is more or less accepted as standard performance, but the real fascination of long distance reception lies in the ability of the receiver to listen in to foreign stations and our Mother Country.

It is difficult to describe the thrill of hearing, direct, Big Ben in London, strike the hour, or the first time one listens in to a station broadcasting in Rome.

Only the owners of ULTIMATE Receivers have experienced the real joys of being unconfined in range of reception. It is a source of marvel to the owner of an ordinary broadcast receiver to hear other owners of shortwave-broadcast receivers comparing notes. They can talk casually about French Indo-China, Rome, London, Siberia, America and a dozen other stations they can receive with good volume and clarity.

Two years ago shortwave was considered to be the hobby of the "crank" and it was quite common to hear dealers recommend their clients not to bother with shortwave, as it was only "freak" reception. The poineers in the construction of shortwave receivers, however, were convinced that the strength with which a shortwave receiver could bring in shortwave stations, was ample proof that the World's shortwave stations could be received on a receiver specially constructed for N.Z. conditions.

For a year they maintained their pioneering work, and about a hundred of these receivers were sold in New Zealand (many of them to the Government lighthouses and the Government ships). Profiting from the experience and enthusiasm of the owners of these shortwave crease the range of reception, and overcome troubles which receivers, the designers and engineers were able to in- hitherto had seemed insurmountable.

The result was that during 1930 over 600 Ultimate receivers were sold throughout New Zealand. The public had come to realise that a broadcast receiver which was just as efficient as any other receiver sold (yet with less background noise as a broadcast receiver) could also operate as a perfect shortwave receiver, and it is safe to say that 1930 marked the definite acceptance of the Ultimate Shortwave and Broadcast Receiver as being the ideal receiver for N.Z. conditions.

The immense amount of experience gained during last year's activities, enabled the designer and those engineering the Ultimate Receiver, to make remarkable progress. It is quite safe to say that no receiver which enjoyed leadership during 1930 has improved 100 per cent. its product for 1931. The Ultimate enjoys this sole distinction.

The new 1931 Ultimate is a revelation in performance, tone, chassis construction and cabinet work. Radio engineers marvel at the performance of this new receiver. It brings in all the world's recognised overseas broadcast stations with splendid clarity and tremendous volume, and it brings in all the world's shortwave stations with a clarity and volume which hitherto has been considered by radio scientists to be impossible.

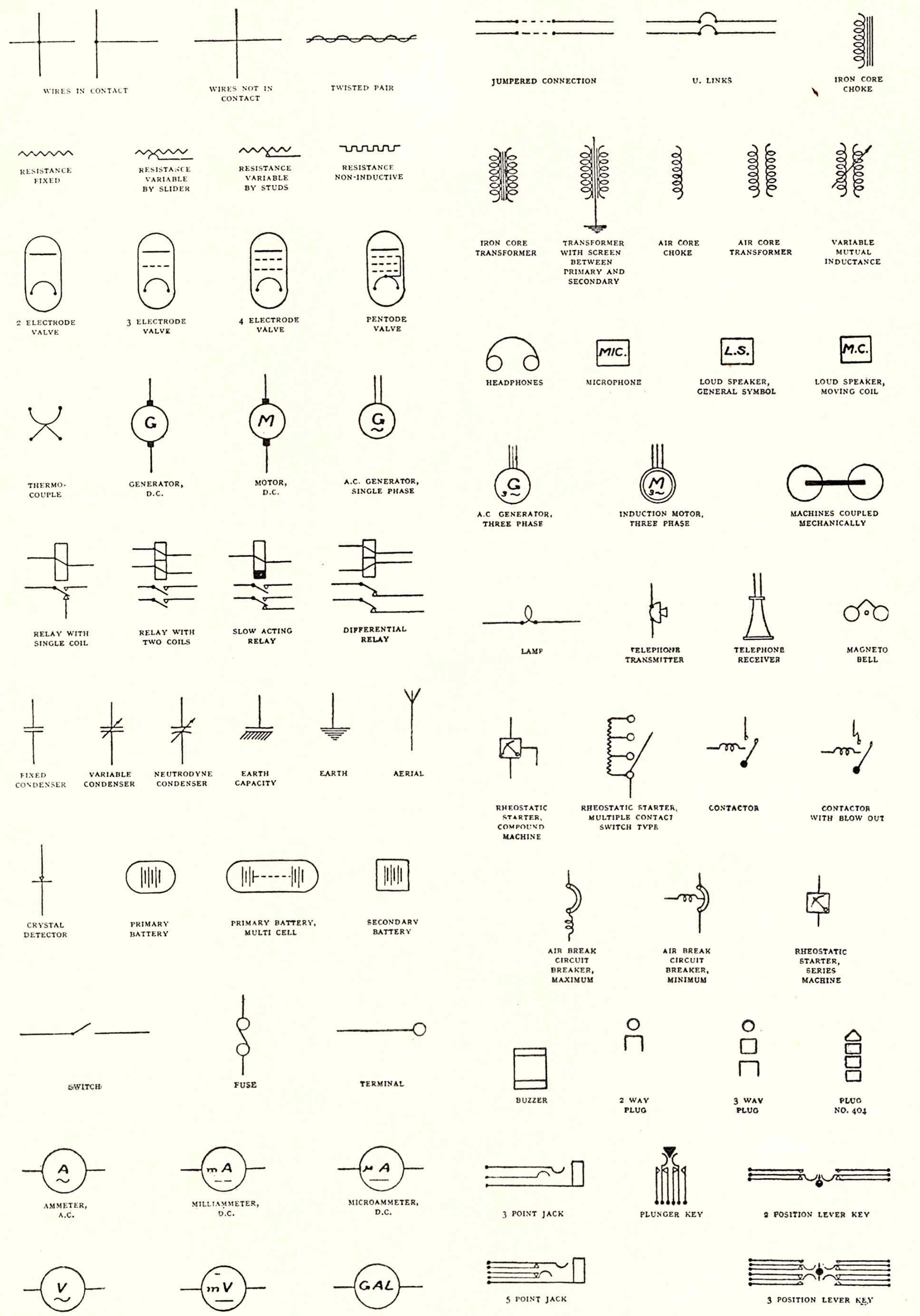
ULTIMATE WORLD RECEIVER ALL WAVE

It will pay every prospective buyer of a radio receiver to investigate the Ultimate, and experience for himself the fascination of listening in to shortwave stations from all round the world.

When television and home-talkies are an established fact in the home, the Ultimate has an attachment for use in connection with this apparatus. If one desires to vary the tone, emphasise high or low frequencies, there is an attachment on the Ultimate so that one can suit his own taste. If tremendous volume is required, suitable for use in a dance hall, provision is made for using gramophone pickup connections, and of course, the Ultimate has the usual gramophone pickup connections for gramophone reproduction.

Anyone interested in learning more about shortwave should send for the leaflet, "What is Shortwave?" A postcard to P.O. Box 1778, Auckland, will bring you this leaflet free of charge.

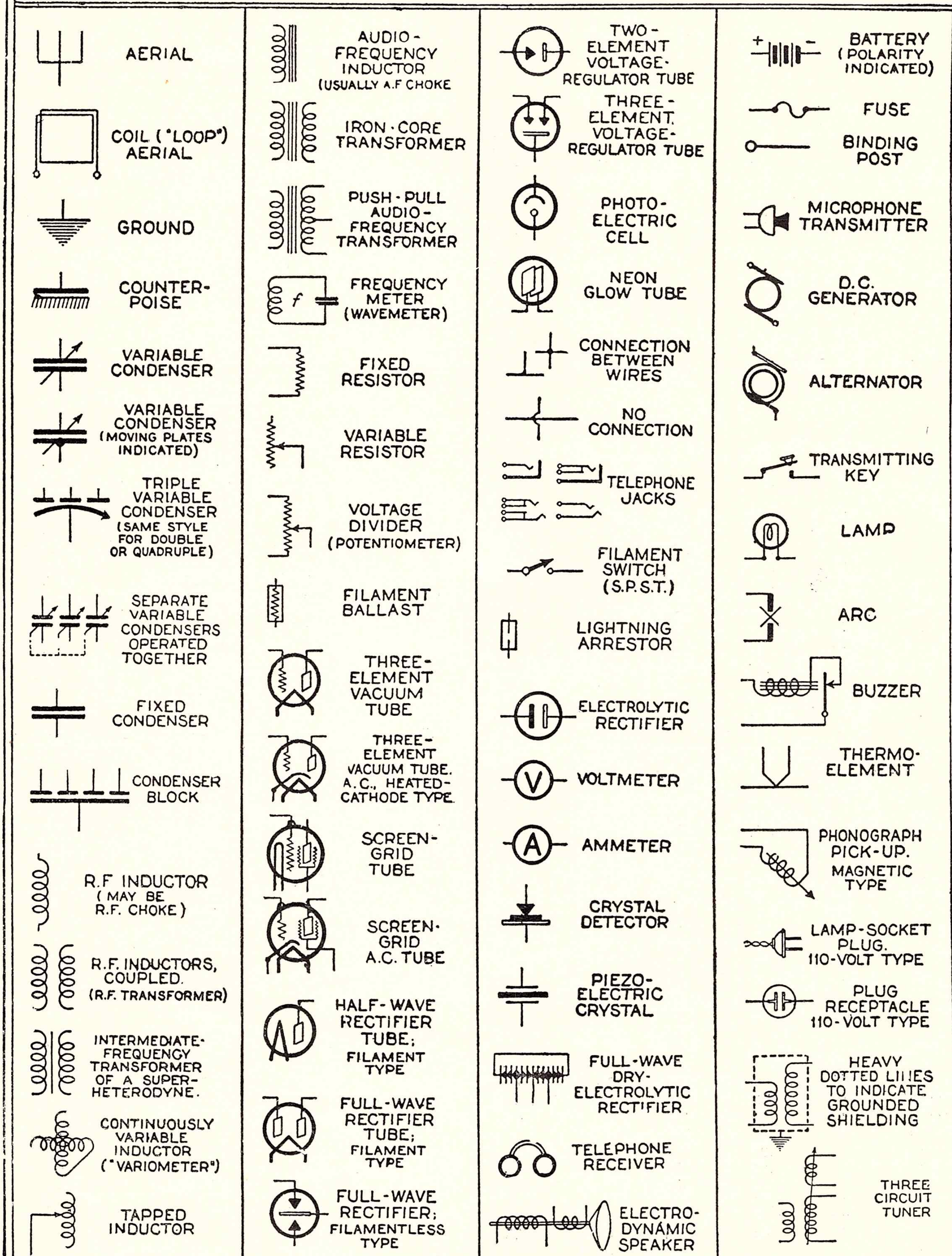
International Electrotechnical Commission Graphical Symbols



NOTE.—The letters L or NL are to be used in conjunction with keys to show locking or non-locking positions. The movement of the levers in above examples is vertical.

For the benefit of readers who may at any time wish to draw or study diagrams we have reproduced the above. On the opposite page will be found American Standard Symbols.

STANDARD RADIO SYMBOLS



PHILIPS VALVE CHARACTERISTICS

A.C.

Valve	Directly or Indirectly Heated	FILAMENT Voltage	FILAMENT Current	Max. Plate Volt	Max. Aux. Grid Volt.	Amp. Factor.	Mut. Cond	Impedance	Neg. Grid. Bias at Max. Plate Volt	Normal Plate	Plate to Grid Capacity MMF
F109	D	1.5	1.25	150	—	9	1.2	7,500	9	5.5	3
F209	I	2.5	1.75	150	—	9	1	9,000	9	7.5	3
F215	I	2.5	1.5	150	—	15	2	7,500	6	6.5	2.5
F242	I	2.5	1.75	180	75	420	1.1	400,000	1.5	4	.01
E409	I	4	.9	150	—	9	3	3,000	9	12	—
E415	I	4	.9	150	—	15	2	7,500	6	6	2.5
E424	I	4	.9	150	—	24	3	8,000	4.5	3	2.5
E430	I	4	.9	150	—	30	2	15,000	3	4	2.5
E435	I	4	.9	200	—	35	1	35,000	1.5	3	.3
E438	I	4	.9	200	—	38	1.5	25,300	3	2.5	2.5
E442	I	4	.9	200	100	—	1.2	—	1.25	1.5	.001
E442S	I	4	.9	200	60	—	1	—	3	3	—

D.C.

Valve	FILAMENT Voltage	FILAMENT Current	Max Plate Voltage	Max. Aux. Grid Volt	Amp. Factor	Mut. Cond.	Impedance	Neg. Grid Bias at Max. Plate Voltage	Normal Plate Current	Plate to Grid Cap. MMF
A109	1.3	.06	150	—	9	.45	20,000	9	2	2
C142	1	.25	150	75	150	1	150,000	3	1.5	.05
C135	1	.25	150	—	35	.6	59,000	1.5	.8	—
A209	2	.08	150	—	9	1	9,000	9	4	2
A409	4	.06	150	—	9	1.2	7,500	9	3.5	2.5
A410	4	.06	150	—	10	.5	20,000	—	5.5	1.2
A414	4	.08	150	—	14	2	7,000	—	4.5	—
E414	4	.90	150	—	14	2	7,000	6	6	—
A415	4	.08	150	—	15	2	7,500	4.5	3	2.5
A425	4	.06	150	—	25	1.2	20,800	3	.8	2.5
A435	4	.06	150	—	35	.5	70,000	—	1.4	.3
A441	4	.08	20	20	4.5	1	4,500	3	1.3	2
A442	4	.06	150	75	—	.8	—	—	2.8	.01
A609	6	.06	150	—	9	1.5	6,000	9	4	3
A615	6	.08	150	—	15	2.4	6,250	1.5	4	2.5
A630	6	.06	150	—	30	1.5	20,000	1.5	.7	3
A635	6	.06	150	—	35	1.5	23,300	—	1.2	.3
A642	6	.06	200	100	—	.7	—	—	4	—

POWER (A.C. or D.C.)

Valve	FILAMENT Voltage	FILAMENT Current	Max. Plate Voltage	Max. Aux. Grid Volt	Amp. Factor	Mut. Cond.	Impedance	Neg. Grid Bias at Max. Plate Voltage	Normal Plate Current	Max Plate Dissipation in Watts
C109	1	.25	150	—	9	1	9,000	8	4	—
D105	1	.6	150	—	5	2	2,500	16	8	—
D143*	1	.65	150	150	100	1.8	55,500	15	12	—
B105	1.3	.15	—	150	5	1	50,000	18	8	—
B203	2	.19	150	—	3	1.5	2,000	30	12	—
F203	2.5	1.5	250	—	3.5	3	1170	50	32	—
B205	2	.15	150	—	5	1.2	4,200	18	7	—
D243*	2.5	.6	300	200	60	1.5	40,000	20	25	—
C243	2	.27	150	150	60	1.5	40,000	15	17	—
B403	4	.15	150	—	3	1.5	2,000	30	15	—
D404	4	.65	200	—	3.5	3.5	1,000	30	30	—
B405	4	.15	150	—	5	2	2,500	18	8	—
B406	4	.1	150	—	6	1.4	4,300	15	7.5	—
E408	4	.90	400	—	8	2	4,000	30	26	10
B409	4	.15	150	—	9	2	4,500	9	6.5	10
B443*	4	.15	150	150	60	1.2	50,000	15	12	—
C443*	4	.25	300	200	60	1.5	40,000	22	22	—
E443*	4	.90	400	300	60	1.8	33,000	35	30	12
F443*	4	—	500	200	60	4	15,000	39	45	—
C603	6	.25	180	—	3	2	1,500	40	18	—
C606	6	.25	250	—	6	3.25	1,850	25	24	6
B605	6	.12	150	—	5	1.8	2,800	18	9	—
C643*	6	.25	300	200	60	1.5	40,000	20	21	—
F704	7.5	1.25	450	—	3.8	2.1	1,800	84	55	25
TB04/10	7.5	1.25	400	—	7.5	2.5	3,750	25	27	10
E406	4	1	250	—	6	6	1,000	24	48	12

***PENTHODES**

Philips Stock Rectifiers for American Sets.

Philips Rectifying Valves. High Tension.

TYPE	506	505	1562	1560	1561	1071	1061	1200	2769
Filament Voltage (V)	4.0	4.0	7.5	5	4	2.1	2.1	4	2.2
Filament Current (A)	1.0	1.0	1.25	2	2	2.8	2.8	4	4.0
Max. Anode Voltage (V)	2x300	200—400	750	2x300	2x500	2x500	2x1000	2x2000	2x1000
Max. Rectified Current (MA)	75	60	110	125	125	100	100	100	75

Philips Transmitting Valves

TYPE	TC04/10	TC03/5	TB04/10	TB1/50	QB2/75	TB2/250	TA4/250
Filament Voltage (V)	4	4	6-7.5	10	10	11	12.5
Filament Current (A)	1	.275	1.25	3.25	3.25	3.8	5.5
Total Emission (mA)	100	100	500	1500	2000	2000	400
Anode Voltage (V)	200-400	150-300	220-400	700-1000	2000	1000-2000	2000-4000
Screen Grid Voltage (V)					300-500		
Max. Anode Dissipation (W)	10	6	10	50	75	150	250
Max. S/G Dissipation (W)					15		
Amplification Factor	25	6	7.5	25	200	25	25
Mutual Conductance (mA/V)	2	2.3	2.5	3	1.4	4	2
Internal Resistance (Ω)	12,500	2,500	3,750	8,000	150,000	6,000	12,500
Anode Control-grid Capacity (mmf)					0.05		

Philips Modulating and Amplifying Valves

TYPE	E408	F704	MB1/50	MC1/50	MB2/200
Filament Voltage (V)	4.0	7.5	10.0	10	11
Filament Current (A)	.9	1.25	3.25	1.5	3.8
Total Emission (M.A.)	400	900	1500	1500	2000
Anode Voltage (V)	200-400	250-450	700-1000	700-1000	1500-2000
Max. Anode Dissipation (W)	10	25	50	50	200
Amplification factor	8	3.8	12	10	14
Mutual Conductance (mA/V)	2.0	2.1	3	4	3
Internal Resistance (ohms)	4000	1800	4000	2500	4500

SEVEN SECOND VALVES!

The standard of performance which the production of the radio valve to-day has reached leaves very little between the leading makes of valves on the market.

The average purchaser of a valve either has a fixed determination to buy the highest priced valve, feeling sure he is getting the best, or is swayed by the assurances of the dealer. He cannot go far astray in either case, but there is no reason why valves should not be intelligently purchased by the set owner.

A little investigation into the merits of the different valves will equip him with sufficient knowledge to know that in buying a certain brand of valve he has an absolute guarantee of performance. The manufacturer gives a broad guarantee of service and replacement which is unquestionable. The selection of a valve, therefore, boils down to—which gives the best value at the price, and what special merits each brand of valve possesses.

Take, for instance, the Arcturus valve, known by its blue colour. This valve is manufactured by one of the oldest valve manufacturing organisations in the industry, pioneers and inventors of certain processes which give splendid advantages. All owners of electric receivers have experienced that irritating wait for valves to heat up before their set is in operation. The Arcturus Company overcame this difficulty and produced, some considerable time ago, "the Seven Second Valve." So short a period is not noticed after switching on the set, but a wait of three or four times that period becomes very irritating each time the set is switched on. Some knowledge of the construction of a valve is useful, and those entirely untechnical can appreciate that a construction which securely anchors the elements both top and bottom must naturally stand greater usage than a type which does not employ this principle.

ARCTURUS A-C VALVES

Type Number		Filament Volts A-C	Filament Current	Plate Volts (Max.)	Output MA
127	DETECTOR AND AMPLIFIER	2.5	1.75	180	
124	SCREEN GRID	2.5	1.75	180	
126	AMPLIFIER	1.5	1.05	180	
145	POWER AMPLIFIER	2.5	1.5	250	
150	POWER AMPLIFIER	7.5	1.25	450	
071	POWER AMPLIFIER	5.0	0.5	180	
180	FULL WAVE RECTIFIER	5.0	2.0	300	125
181	HALF WAVE RECTIFIER	7.5	1.25	750	110

RCA RADIOTRON VALVE CHARACTERISTICS

AVERAGE CHARACTERISTICS OF RECEIVING RADIOTRONS

	GENERAL									DETECTION				AMPLIFICATION						
	MODEL	USE	CIRCUIT REQUIREMENTS	BASE	MAXIMUM OVERALL HEIGHT	MAXIMUM OVERALL DIAMETER	"A" SUPPLY	FILAMENT TERMINAL VOLTAGE	FILAMENT CURRENT (AMPERES)	DETECTOR GRID RETURN LEAD TO	GRID LEAK (MEGOHMS)	DETECTOR "B" BATTERY VOLTAGE	DETECTOR PLATE CURRENT (MILLIAMPERES)	AMPLIFIER "B" BATTERY VOLTAGE	AMPLIFIER "C" BATTERY VOLTAGE	AMPLIFIER PLATE CURRENT (MILLIAMPERES)	A.C. PLATE RESISTANCE (OHMS)	MUTUAL CONDUCTANCE (MICROMHOS)	VOLTAGE AMPLIFICATION FACTOR	MAXIMUM UNDISTORTED OUTPUT (MILLIWATTS)
DETECTORS AND AMPLIFIERS	RADIOTRON WD-11	Detector or Amplifier	Transformer Coupling	WD-11 Base	$4\frac{1}{8}$"	$1\frac{3}{16}$"	Dry Cell $1\frac{1}{2}$ V. Storage 2 V.	1.1	.25	+F	3 to 5	$22\frac{1}{2}$ to 45	1.5	90 135	$4\frac{1}{2}$ $10\frac{1}{2}$	2.5 3.5	15,500 15,000	425 440	6.6 6.6	7 35
	RADIOTRON WX-12	Detector or Amplifier	Transformer Coupling	Large Standard UX Base	$4\frac{11}{16}$"	$1\frac{7}{16}$"	Dry Cell $1\frac{1}{2}$ V. Storage 2 V.	1.1	.25	+F	3 to 5	$22\frac{1}{2}$ to 45	1.5	90 135	$4\frac{1}{2}$ $10\frac{1}{2}$	2.5 3.5	15,500 15,000	425 440	6.6 6.6	7 35
	RADIOTRON UX-112-A A	↓ Detector or Amplifier	Transformer Coupling	Large Standard UX Base	$4\frac{11}{16}$"	$1\frac{13}{16}$"	Storage 6 V.	5.0	.25	+F	3 to 5	45	1.5	90 135	$4\frac{1}{2}$ 9	5.5 7	5,300 5,000	1,500 1,600	8 8	30 120
	RADIOTRON UV-199	Detector or Amplifier	Transformer Coupling	UV-199 Base	$3\frac{1}{2}$"	$1\frac{1}{16}$"	Dry Cell $4\frac{1}{2}$ V. Storage 4 V.	3.0 3.3	.060 .063	+F	2 to 9	45	1	90	$4\frac{1}{2}$	2.5	15,500	425	6.6	7
	RADIOTRON UX-199	Detector or Amplifier	Transformer Coupling	Small Standard UX Base	$4\frac{1}{8}$"	$1\frac{3}{16}$"	Dry Cell $4\frac{1}{2}$ V. Storage 4 V.	3.0 3.3	.060 .063	+F	2 to 9	45	1	90	$4\frac{1}{2}$	2.5	15,500	425	6.6	7
	RADIOTRON UX-200-A	Detector	Transf. or Resist. Coupling	Large Standard UX Base	$4\frac{11}{16}$"	$1\frac{13}{16}$"	Storage 6 V.	5.0	.25	-F	2 to 3	45	1.5	Following UX-200-A Characteristics apply only for Detector Connection			30,000	666	20	—
	RADIOTRON UX-201-A	Detector or Amplifier	Transformer Coupling	Large Standard UX Base	$4\frac{11}{16}$"	$1\frac{13}{16}$"	Storage 6 V.	5.0	.25	+F	2 to 9	45	1.5	90 135	$4\frac{1}{2}$ 9	2.5 3	11,000 10,000	725 800	8 8	15 55
	RADIOTRON UX-222	↓ Radio Freq Amplifier	Special Shielding (See Inst. Sheet)	Large Standard UX Base	$5\frac{3}{8}$"	$1\frac{13}{16}$"	Dry Cell $4\frac{1}{2}$ V. Storage 4.6 V.	3.3	.132	—	—	—	—	135	$1\frac{1}{2}$ #	1.5	850,000	350	300 M	—
	RADIOTRON UX-222	↑ Audio Freq Amplifier	Resistance Coupling (See Inst. Sheet)	Large Standard UX Base	$5\frac{3}{8}$"	$1\frac{13}{16}$"	Dry Cell $4\frac{1}{2}$ V. Storage 4.6 V.	3.3	.132	—	—	—	—	180 ǂ	$1\frac{1}{2}$ □	.3	150,000	400	60	---
	RADIOTRON UX-225	Amplifier A-C Filament Type	Transformer Coupling	Large Standard UX Base	$4\frac{11}{16}$"	$1\frac{13}{16}$"	Transformer 1.5 V.	1.5	1.05	—	—	—	—	90 135 180	6 9 $13\frac{1}{2}$	3.5 6 7.5	9,400 7,400 7,000	875 1100 1170	8.2 8.2 8.2	20 70 160
	RADIOTRON UY-227	Detector A-C Heater Type	Transformer Coupling	5 Prong Standard UY Base	$4\frac{11}{16}$"	$1\frac{13}{16}$"	Transformer 2.5 V.	2.5 H	1.75	C	2-9 1-1	45 90	2 7	Following UY-227 Characteristic apply only for Detector Connection			10,000 8,000	800 1,000	8 8	—
	RADIOTRON UX-240	Detector or Amplifier	Resistance Coupling	Large Standard UX Base	$4\frac{11}{16}$"	$1\frac{13}{16}$"	Storage 6 V.	5.0	.25	+F	2 to 5	135 ǂ 180 ǂ	.3 .4	135 ǂ 180 ǂ	$1\frac{1}{2}$ 3	2 .2	150,000 150,000	200 200	30 30	—
POWER AMPLIFIERS	RADIOTRON UX-112-A A	↑ Power Amplifier	No L S C Required	Large Standard UX Base	$4\frac{11}{16}$"	$1\frac{13}{16}$"	Storage 6 V Transformer 5 V.	5.0	.25	—	—	—	—	135 $157\frac{1}{2}$	9 $10\frac{1}{2}$	7 9.5	5,000 4,700	1 600 1 700	8 8	120 195
	RADIOTRON UX-120	Power Amplifier	No L S C Required	Small Standard UX Base	$4\frac{1}{8}$"	$1\frac{3}{16}$"	Dry Cell $4\frac{1}{2}$ V. Storage 4 V	3.0 3.3	.125 .132	—	—	—	—	135	$22\frac{1}{2}$	6.5	6,300	525	3.3	110
	RADIOTRON UX-171-A A	Power Amplifier	L S C Except at 90 V.	Large Standard UX Base	$4\frac{11}{16}$"	$1\frac{13}{16}$"	Storage 6 V. Transformer 5 V	5.0	.25	—	—	—	—	90 135 180	$16\frac{1}{2}$ 27 $40\frac{1}{2}$	10 16 20	2,500 2,200 2,000	1,200 1,360 1,500	3.0 3.0 3.0	130 330 700
	RADIOTRON UX-210	Power Amplifier	L.S.C.	Large Standard UX Base	$5\frac{5}{8}$"	$2\frac{3}{16}$"	Transformer 7.5 V.	7.5	1.25	—	—	—	—	250 300 350 400 425	18 $22\frac{1}{2}$ 27 $31\frac{1}{2}$ 35	10 13 16 18 18	6000 5600 5150 5000 5000	1330 1450 1550 1600 1600	8 8 8 8 8	340 600 925 1325 1540

	MODEL	USE	CIRCUIT REQUIREMENTS	BASE	MAXIMUM OVERALL HEIGHT	MAXIMUM OVERALL DIAMETER	PURPOSE		
RECTIFIERS	RADIOTRON UX-280	Full-Wave Rectifier	Full-Wave Circuit	Large Standard UX Base	$5\frac{5}{3}$"	$2\frac{3}{16}$"	Rectification in Eliminators Designed for this Radiotron or Rectron UX-213	Filament Terminal Voltage....5 Volts Filament Current............2 Amperes } R M S A. C. Plate Voltage........300 Volts (Max. per plate)	Max. D. C. Output Current (both plates)........125 Milliamperes D. C. Output Voltage at max. current as applied to filter of typical rectifier circuit.....260 Volts
	RADIOTRON UX-281	Half-Wave Rectifier	Half or Full Wave Circuit	Large Standard UX Base	$6\frac{1}{4}$"	$2\frac{7}{16}$"	Rectification in Eliminators Designed for this Radiotron or Radiotron UX-216 B	Filament Terminal Voltage...7.5 Volts Filament Current.........1.25 Amperes } R M S A. C. Plate Voltage.......750 Volts (Maximum)	Recommended / Maximum A. C. Plate Voltage........650........750 Volts D. C. Output Current........65........110 Milliamperes D. C. Output Voltage as applied to filter of typical rectifier circuit........620........620 Volts
MISCELLANEOUS	RADIOTRON UX-874	Voltage Regulator	Series Resistance	Large Standard UX Base	$5\frac{5}{8}$"	$2\frac{3}{16}$"	Constant Voltage Device	Designed to keep output voltage of B eliminators constant when different values of "B" current are supplied	Operating Voltage........90 Volts D.C. Starting Voltage........125 Volts D.C. Operating Current........10-50 Milliamperes
	RADIOTRON UV-876	Current Regulator (Ballast Tube)	Transformer Primary of 65 Volts for use on 115 Volt Line	Standard Mogul Type Screw Base	8"	$2\frac{1}{16}$"	Constant Current Device	Designed to insure constant input to power operated radio receivers despite fluctuations in line voltage	Operating Current........1.7 Amperes Mean Voltage Drop........50 Volts Permissible Variation........±10 Volts
	RADIOTRON UV-886	Current Regulator (Ballast Tube)	Transformer Primary of 65 Volts for use on 115 Volt Line	Standard Mogul Type Screw Base	8"	$2\frac{1}{16}$"	Constant Current Device	Designed to insure constant input to power operated radio receivers despite fluctuations in line voltage	Operating Current........2.05 Amperes Mean Voltage Drop........50 Volts Permissible Variation........±10 Volts

↑ (↓) Note other use of this Radiotron above (below)
\# Inner Grid - $1\frac{1}{2}$ Volts; Outer Grid +45 Volts, .15 Milliamperes
□ Outer Grid - $1\frac{1}{2}$ Volts; Inner Grid + $22\frac{1}{2}$ Volts, 6 Milliamperes
ǂ Applied thru plate coupling resistance of 250,000 Ohms

Note: All grid voltages are given with respect to cathode or negative filament terminal

Max. Values not to be exceeded

A....... Except for half ampere filament, UX-112 and UX-171 characteristics are identical respectively to UX-112-A and UX-171-A.
C....... Cathode
H....... Heater Voltage
L S C... Loud Speaker Coupling, consisting of either Choke Coil and By-Pass Condenser or Output Transformer of 1 : 1 or step down ratio, recommended wherever plate current (D C) exceeds 10 milliamperes.
M ...... With a screen-grid tube, on account of circuit limitations, the actual voltage amplification obtainable does not bear as high a relation to the voltage amplification factor as in the case of three element tubes

Characteristics of MAJESTIC A-C Valves

	Filament Volts	Filament current amps	Plate Voltage	Neg. Grid Bias.	Plate Current M/A	Plate Resistance Ohms.	Mutual Conductance Microms	Ampli. Factor	Power Output Milli-watts	Screen Voltage	Screen Current M/A	D.C. Output Current M/A	D.C. Output Voltage
G71A	5.0	.25	180	40½	20	2000	1500	3.0	700				
G26	1.5	1.05	180	13½	7.5	7000	1170	8.2	160				
G27	2.5	1.75	Det. 90		7.	8000	1000	8					
G24	2.5	1.75	180	1.5	4	400,000	1050	420		75	0.3		
G45	2.5	1.5	180-250	33_50	26_32	1950_1900	1800_1850	3.5_3.5	750_1600 Mil. wts.				
G80	5.0	2.0	300									125	260

Characteristics of STANDARD Valves

Code of Valve	Output as Oscillator (Watts)	IA (Amps.)	EA (Volts)	Amp. Fact. (u)	EB Sa.e Max. (Volts)	Max Dissipation (Watts)	EB (Volts)	EC (Volts)	IB (Mille amps.)	RO (Ohms)	Gain (db.)	Output Power (Watts)	Type and Uses
4001-A	—	0.25	1.0	11.4	90	—	60	— 1.5	0.7	45000	27.5	.0041	R.
4001-AB	—	0.25	1.0	11.4	90	—	60	— 1.5	0.7	45000	27.5	.0041	R.
4215-A	0.1	0.25	1.0	6	60	0.2	45	— 3	1.0	25000	24	.008	R.
4215-AB	0.1	0.25	1.0	6	60	0.2	45	— 3	1.0	25000	24	.008	R.
4239-A	—	0.27	1.0	6	130	—	100	— 7	1.5	20000	—	—	R.
4102-D	—	0.97	2.0	30	160	0.3	130	— 1.5	0.75	60000	33.5	.0042	C.M.P. R.T.
4002-A	—	0.265	4.0	6.6	130	—	130	— 8	4.5	6000	30	.019	R.
4002-AB	—	0.265	4.0	6.6	130	—	130	— 8	4.5	6000	30	.019	R.
4101-D	1.0	0.97	4.4	5.9	160	2.5	130	— 9	8	6000	29.5	.059	C.M. R.T.
4101-DL	1.0	0.97	4.4	5.9	160	2.5	130	— 9	8	6000	29.5	.059	R.
4104-D	2.0	0.97	4.4	2.5	160	5.0	130	— 20	20	2000	26	0.17	C.M.T.
4205-D	5.0	1.6	4.5	7	350	15	250 or 300	— 15 to — 30	45	3500	33	.89	P.R.
4205-E	5.0	1.6	4.5	7	350	15	250 or 300	— 15 to — 30	45	3500	33	.89	P.R.
4211-D	50	3.0	10	12	1000	65	750	— 30	65	3000	38	4.6	P.R.
4211-E	50	3.0	10	12	1000	65	750	— 30	65	3000	38	4.6	R.
SS-2029-I	—	3.0	10	31	1000	65	750	— 12	22	11200	43	2.4	R.
ES-755-1	20	1.6	8.0	8.5	750	30	500	— 30	50	3200	35	2.5	P.R.
ES-755-2	20	1.6	8.0	4.2	500	30	350	— 45	60	1650	32	2.5	P.R.
4212-D	250	6.0	14	16	2000	200	1500	— 60	130	2000	43	45	P.R.
SS-1969-1	1000	41	10	20	—	1500	4000	—	—	8000	—	—	Air cooled Short wave
SS-1966-2	1000	24	14	23	—	—	4000	—	—	8500	—	—	Water cooled Short wave
4220-B	10000	41	22	40	—	15000	10000	—	—	6000	—	—	Water cooled Long wave
4222-A	—	41	22	—	—	2 amps. at 15000 V.	—	—	—	—	—	— —	Water cooled Diode
4228-A	4000	41	22	16	—	7500	4000	—	—	2000	—	—	Water cooled Long wave
4006	10000	49	19-21	40	—	15000	10000	—	—	6000	—	—	Water cooled Long wave
4007	—	49	19-21	—	—	2 amps. at 15000 V.	—	—	—	—	—		Water cooled Diode
SS-1968	10000	41	21-24	40	—	15000	10000	—	—	6000	—	—	Water cooled Short wave

CHARACTERISTICS OF MULLARD VALVES

Mullard Screen Grid Valves

Type	Filament Volts	Filament Amps.	Max. Anode Voltage	Optimum Screen Voltage	Average Anode Current	Amplification Factor	A.C. Resistance (Ohms)	Anode-Grid Capacity
P.M. 12	2.0	0.15	150	75	2.0	200	212,000	0.005
P.M. 14	4.0	0.075	150	75	2.0	200	230,000	0.005
P.M. 16	6.0	0.075	150	75	2.3	200	200,000	0.005
S4V	4.0	1.0	200	75	0.85	1000	909,000	0.005
S4VA	4.0	1.0	200	75	0.6	1500	430,000	0.0015
S4VB	4.0	1.0	200	75	3.5	900	257,000	0.0015

Mullard Miscellaneous Valves

Type	Filament Volts	Filament Amps.	A.C. Resistance (Ohms)	Amplification Factor	Mutual Conductance MA/VOLT	A Max. Anode Volts	B Grid Bias (for A)	Average Anode Current (for A & B MA)
P.M. 1A	2.0	0.1	51,000	36	0.7	150	1½	0.85
P.M. 1HF	2.0	0.1	22,500	18	0.8	150	3	1.5
P.M. 1LF	2.0	0.1	12,000	11	0.9	150	7½	3.4
P.M. 2DX	2.0	0.2	10,700	13.5	1.25	150	6	2.7
P.M. 3A	4.0	0.075	55,000	38	0.66	150	1½	0.65
P.M. 3	4.0	0.075	13,000	14	1.05	150	6	2.8
P.M. 4DX	4.0	0.1	7,500	15	2.0	150	6	2.5
P.M. 5X	6.0	0.075	14,700	17.5	1.2	150	3	2.8
P.M. 5D	6.0	0.075	20,000	26	1.3	150	3	1.2
P.M 5B	6.0	0.075	53,000	40	0.75	150	1½	0.6
P.M. 6D	6.0	0.1	9,000	18	2.0	150	4½	2.5

Mullard Indirectly Heated A.C. Valves

Type	Filament Volts	Filament Amps.	A.C. Resistance (Ohms)	Amplification Factor	Mutual Conductance MA/VOLT	A Max. Anode Volts	B Grid Bias (for A)	Average Anode Current (for A & B MA)
P.M. 354V	4.0	1.0	11,700	35	3.0	200	4	4.0

Mullard Output Valves

Type	Filament V.	Filament A.	A.C. Resistance (Ohms)	Amplification Factor	Mutual Conductance	A Max. Anode Volts	B Grid Bias	C Average Anode Current	D Max. Undistorted Output	G Optimum Load
PM2	2.0	0.2	4,400	7.5	1.7	150	12	6.6	150	9,000
PM2A	2.0	0.2	3,600	12.5	3.5	150	6	8.0	270	8,000
PM252	2.0	0.3	2,600	5.4	2.1	150	15	16.0	320	6,000
PM4	4.0	0.1	4,450	8.0	1.8	150	12	7.0	170	9,500
PM254	4.0	0.18	2,000	4.2	2.1	150	22½	12.0	400	4,500
PM6	6.0	0.1	3,550	8.0	2.25	150	9	9.5	160	8,000
PM256	6.0	0.25	1,850	6.0	3.25	250	26	20.0	800	5,000
PM256A	6.0	0.25	1,400	3.6	2.6	200	33	30.0	900	3,600
DO/20	7.5	1.3	2,000	5.0	2.5	425	66	40.0	3000	6,000
DO/25	6.0	1.8	1,150	3.0	2.6	400	95	63.0	5000	3,100
DO/60	6.0	4.0	1,000	3.5	3.5	500	95	120	12000	2,900

Mullard Indirectly Heated A.C. Valves

Type	Filament V.	Filament A.	A.C. Resistance (Ohms)	Amplification Factor	Mutual Conductance	A Max. Anode Volts	B Grid Bias	C Average Anode Current	D Max. Undistorted Output	G Optimum Load
164V	4.0	1.0	6,650	16.0	2.4	200	8½	8.0	270	13,000
104V	4.0	1.0	2,850	10.0	3.5	200	12	17.0	600	6,000

Mullard Directly Heated A.C. Valves

Type	Filament V.	Filament A.	A.C. Resistance (Ohms)	Amplification Factor	Mutual Conductance	A Max. Anode Volts	B Grid Bias	C Average Anode Current	D Max. Undistorted Output	G Optimum Load
A.C. 104	4.0	1.0	2,850	10.0	3.5	200	14	11.0	400	6,000
A.C. 064	4.0	1.0	2,000	6.0	3.0	200	21	20.0	750	4,300
A.C. 044	4.0	0.7	1,150	4.0	3.5	200	32	30.0	1020	2,500

Mullard Pentode Valves

Type	Filament V.	Filament A.	Mutual Conductance	A Max. Anode Voltage	E Max. Screen Voltage	B Grid Bias	C Average Anode Current	F Average Screen Current	D Max. Undistorted Output	G Optimum Load
PM22	2.0	0.3	1.3	150	150	12	13	4	400	11,000
PM24	4.0	0.15	1.75	150	150	12	20	5	500	10,000
PM26	6.0	0.17	2.0	150	150	15	19	5	750	9,000
PM24A	4.0	0.275	2.0	300	200	21	21	6	1500	8,000
PM24B	4.0	1.0	2.1	400	300	40	20	6	3000	—

Mullard Rectifying Valves

Type	Filament V.	Filament A.	Type of Rectification	Max. Anode Volts R.M.S.	Max. D.C. Output (unsmoothed). Volts	Max. D.C. Output (unsmoothed). Ma.
DU 1	4.0	0.6	Half wave	250	250	30
DU 10	4.0	1.0	Half wave	250	250	75
DU 4	4.0	1.0	Half wave	500	500	60
DW 1	4.0	0.6	Full wave	250-0-250	260	30
DW 2	4.0	1.0	Full wave	250-0-250	250	60
DU 2	4.0	1.0	Full wave	250-0-250	250	75
DW 3	5.0	1.0	Full wave	425-0-425	450	60
DU 15	7.5	0.6	Half wave	500	520	60
DW 15	7.5	0.6	Full wave	500-0-500	560	60
DW 30	7.5	2.4	Full wave	500-0 500	500	120

Useful Indoor Aerial

THERE can be no doubt about the usefulness of a good indoor aerial. When the set itself is not particularly selective, when, in fact, it provides rather more magnification than its selectivity warrants (judged on an outdoor aerial), good results are to be obtained from a relatively short aerial. Those who are not afraid to put up an aerial in such a way that it is fairly efficient will usually obtain good reults. The difficulty is, that many people consider that an indoor aerial need comprise just a fine wire tacked to the picture rail. With such an aerial the range of reception is restricted. Some people put the aerial along a passage, or in the loft of the house and are satisfied with the results. Others use a short length of wire and take care to arrange it well away from walls and the ceiling. By doing this they provide an aerial which is small but good.

Battery Receivers

THERE are many owners of all-electric receivers to-day who unreservedly claim that the reproduction and performance of the electric receiver has not yet surpassed that of the battery receiver prior to the introduction of the all-electric type.

Those not enjoying the advantages of being in reticulated areas will have the satisfaction of knowing that they can secure radio reception with equal efficiency, and, in many cases, with less complications than the all-electric receiver. The tendency during the past two years has been to add the greatest number of valves which means additional apparatus and greater chance of breakdown.

Notwithstanding the advance of the electric receiver radio engineers have not overlooked the needs of those requiring battery sets, and the progress made during the past year in the construction of battery receivers has been just as marked as with the electric type. There is one great advantage with the battery receiver in that it does not require to operate a large number of valves to secure satisfactory results. The screen grid and pentode valves each can claim the performance of two of the ordinary type of valve, so that a four-valve battery receiver to-day gives the performance of the six-valve battery receiver of last year.

As valve manufacturers evolve fresh types and improve their performance, so is the performance of the receiver improved, and it is with a full knowledge of the improvements and characteristics of the latest battery valves that the new Courier battery receiver has been designed to give results hitherto not possible on battery receivers. The Courier employs only four valves, but is equal in performance to a six-valve receiver, besides having the advantage of using regeneration which further increases its performance.

The latest 1931 Courier has also been designed to operate on shortwave and efficiently reproduces the world's shortwave stations at good loudspeaker strength, besides which is receives all the recognised overseas broadcast stations. It is not necessary, therefore, for those not connected to the electric current to be without any of the advantages enjoyed by those in reticulated areas.

The Courier, complete with batteries, valves, speaker and shortwave coils is under £30.

What Next?

Radio has grown so fast that it almost requires a Schneider Aeroplane to keep up with its ramifications. Certainly the past year has been very interesting to us, because of the new problems which we have successfully solved.

First, when we decided to go "on the air," we were determined to obtain really good quality of reproduction, and in entrusting the construction of the apparatus to two of the members of our staff who are very old hands at the Amateur Transmitting game, our instructions were terse—"Do the job, but no excuses."

So it was that 1ZJ, which broadcasts on Tuesday and Thursday 12-2 p.m., and Wednesday 7.30-9.30 p.m., came into being. We have been proud of the result (and of the very favourable comments of which we have received so many), and perhaps more so of the fact that the whole outfit was constructed within our firm. We are proud—and so should you be—to know that such a job was undertaken and put through almost without a single hitch.

The next problem was of an entirely different nature. Hotel Titirangi required a Radio-Gramophone installation. We immediately realised that no standard machine would fill the bill, so we suggested a plan, which we subsequently followed.

This consists of a Hammarlund Hi-Q Radio Chassis (noted for its wonderful selectivity and tone) and a separate Loftin-White amplifier such as we build for Talkies. This system allows of the operation of the whole plant from the Office, where the Chasses, Switches, Gramophone motor, etc., are located.

Two Speakers adequately serve the Cabaret, while there are four other speakers on different floors.

Very simple switchgear allows all speakers to be operated from the Amplifier—all speakers to be operated from the Radio—Cabaret Speakers to be operated from the Amplifier, while other speakers operate from Radio, and vice versa—And finally, should the amplifier fail, the Radio can be immediately switched on to the Cabaret Speakers and used as an Electric Gramophone.

We believe the outfit to be easily the most up-to-date of its kind in this country. It was all designed and installed by our firm.

Not long after 1ZJ was heard over the air, Messrs. Lewis Eady decided to equip their 1ZR. It was perhaps only natural that, with 1ZJ so successful, we should be invited to co-operate, and the job was eventually placed in our hands, with instructions to have it ready in ONLY THREE WEEKS.

On the appointed night, 1ZR was ready, and ever since has been working to schedule. Again, there is no need to discuss the success of the station—you have probably decided this for youreslf long since

A smaller, but nevertheless unusual installation was next taken in hand—the equipping of a Dance Hall in Waiheke with a powerful electro-gramophone, with no current supply available. Luckily, the Magneto "B" supply came to our assistance, and the necessary equipment was designed to work in conjunction with it. Again, everything was special, but the plant was ready up to time, and has more than fulfilled expectations.

Finally, we have been drawn into the Talkie business, having manufactured a number of special amplifiers for these exacting demands, supplying modern experimental speakers to suit.

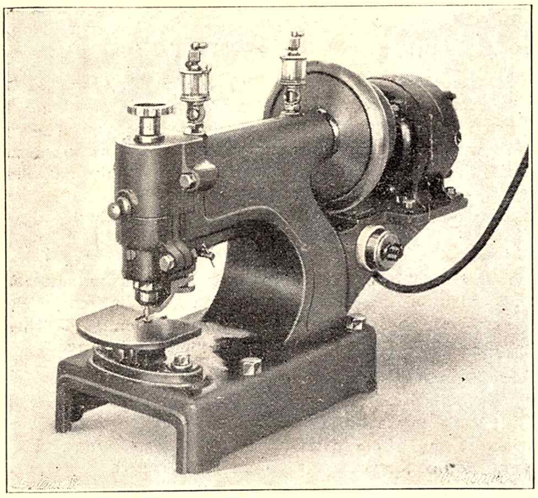
We are proud of these achievements, particularly as each has broken somewhat new ground, and of our organisation, which, backed by loyal members of its staff, has accomplished, and accomplished well, problems that are not met every day.

You, too, should be right glad that you have, here in your midst, an organisation which is able to tackle new problems with such success. We, in turn, merely wonder "WHAT NEXT".

Johns Ltd.

Some Interesting Machines

NIBBLER.—This heavy "SEWING MACHINE" has a strong punch replacing the needle, and rapid movement of the punch up and down enables intricate designs to be "nibbled away" in sheet metal up to about 1/12 inch thick iron. Such work is impossible with ordinary tools.



If you have any special patterns to cut in sheet metal, let our "NIBBLER" do it for you.

ENGRAVING MACHINE.—Really finely finished work requires precision tools. The engraving machine consists of a rigid and accurate pantograph, enabling reduction of the guide letters from a third to a sixteenth, the adjustments taking only a few moments. The cutting is done by a finely pointed tool revolving at 6000 revs. per minute, and guided by the pantograph.

It will engrave almost any material, and is a British machine, being recognised as the best of its class. It costs a mere £120, but is available for any special work in the engraving line that you may want.

WINDING MACHINES.—We use two—one being heavier than the other. It is fascinating to see these when winding coils for transformers, etc., at 2000 to 3000 revs. per minute, laying paper between successive layers of wire, without stopping. Needless to say, these machines are in almost continuous use.

BENDING MACHINES.—The former Tinman's benders have long been discarded for a heavy precision bender, handling thin or thick panels alike, and putting each bend exactly where it is wanted. The beautiful finish of **Well-Mayde** Shields and Cabinets is due largely to this machine.

ELECTRIC WELDER.—This is our newest "baby." A Metal Chassis, after being bent to shape, is fastened by spot welding, making a much quicker and more rigid job than screws and nuts. Besides, a welded job never breaks loose again. The speed of making welds is phenomenal.

DUCO SPRAYER.—The modern finish, whether on wood or metal, is some form of Cellulose Spray, commonly called Duco. Our plant is full size, and best quality, just as used for the most expensive motor work. Once on, Duco is there to stay, and actually improves with age.

Space forbids more than casual mention of other machinery, such as the usual Woodworking Circular and Bandsaws, Moulder, and Buzzer—Enamelling Stove, Guillotine, Fly Press, Punches, Eyeletter—but we must mention that our Laboratory is equipped with Electric Testing Apparatus such as is rarely found elsewhere in this country.

The trade mark adopted by this factory is WELL-MAYDE, and when you see this brand, you know that it stands as a guarantee of good material, design, and workmanship—the product of fellow New Zealanders.

If you have any special problem, consult us.

JOHNS LTD., Chancery Street, AUCKLAND

Wavelengths and Kilocycles

THE place of broadcasting stations in the transmitting band is being designated now by kilocycles—a measure of the frequency of oscillations in the transmitting aerial—as well as by the original method of wavelengths in metres. A table is given below showing some corresponding values of wavelengths in metres and kilocycles. It is impossible to state figures for every wavelength in use, but calculations for other cases are easy from the following formulae:

$$\text{Wavelength in metres} = \frac{300{,}000}{\text{kilocycles}}$$

$$\text{Kilocycles} = \frac{300{,}000}{\text{Wavelength-in-metres}}$$

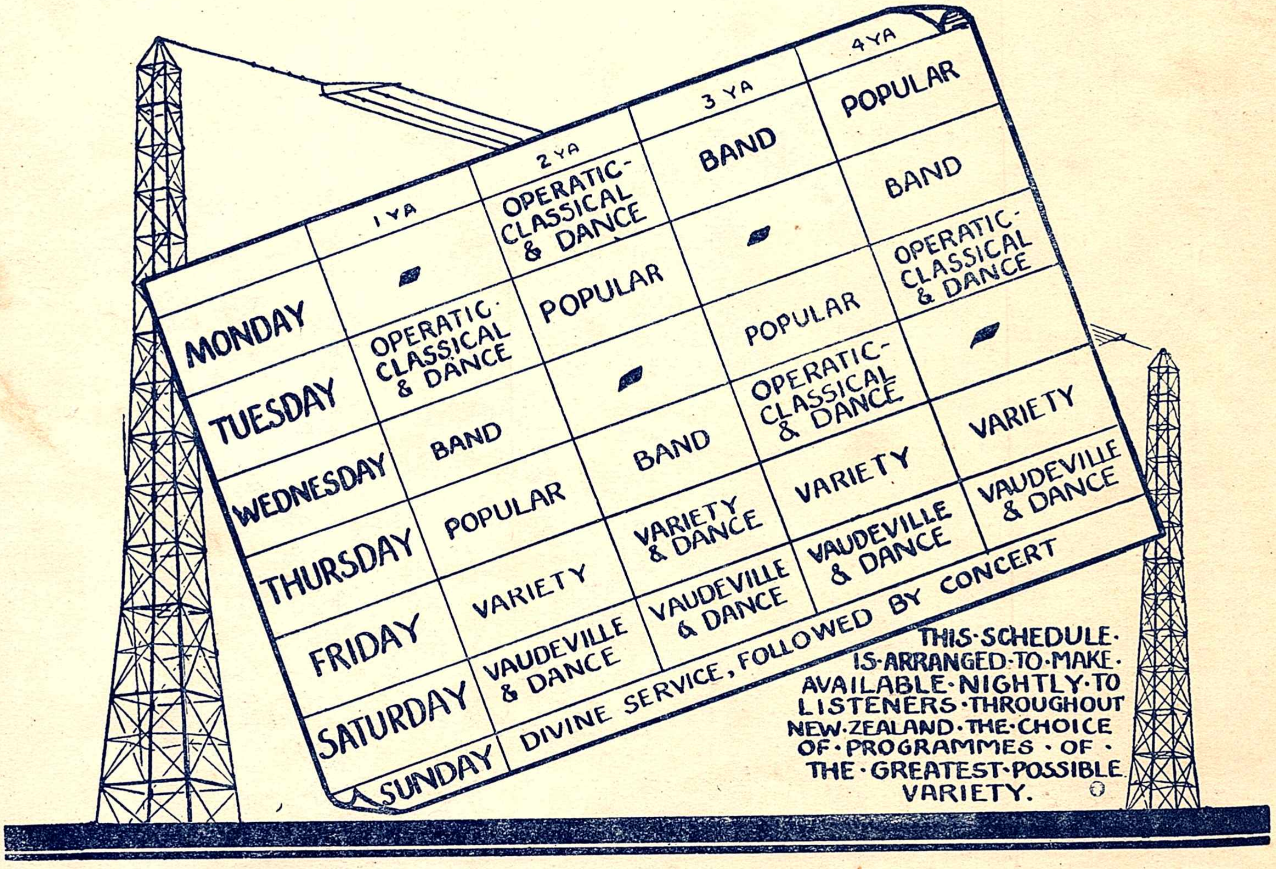
Wavelength.	Kilocycles.	Wavelength.	Kilocycles.
10	30,000	330	909
20	15,000	340	882
30	10,000	350	857
40	7,500	360	833
50	6,000	370	811
60	5,000	380	789
70	4,286	390	769
80	3,750	400	750
90	3,333	410	732
100	3,000	420	714
150	2,000	430	698
200	1,500	440	682
210	1,428	450	667
220	1,363	460	652
230	1,304	470	638
240	1,250	480	625
250	1,200	490	612
260	1,154	500	600
270	1,111	510	588
280	1,071	520	577
290	1,034	530	566
300	1,000	540	556
310	968	550	545
320	937	560	536

Expression of transmitting constants in terms of kilocycles is useful to indicate the number of broadcasting stations which may operate simultaneously without interference. Thus, allowing the usual 10 kilocycles for each station, it can be seen that two stations with overlapping transmitting ranges can operate together between 300 and 310 metres, whereas 250 broadcasting stations are possible between 30 and 40 metres.

A Sound Rule

THE soundest of sound rules is to vet your valves or have them vetted at the end of their first thousand hours' working. This applies particularly to low-impedance valves of large emission, for with them the sensitising ingredients are likely to be used up more quickly than in types whose emission is not so copious. The effects on quality, too, are particularly serious if the output valve is "drying up." How should a valve be vetted? Well, here is my tip. When it comes into service put it into its appropriate holder in the set, make the H.T. volts 100, and apply the proper grid bias. Then put a milliammeter into the H.T positive lead that serves it and read the current passing. On a small stick-on label write the date and, say, "H.T. 100; G.B. —7½, 6 milliamperes." Vetting simply means repeating the process.

Programme Schedule of Y.A. Stations



	1 YA	2 YA	3 YA	4 YA
MONDAY		OPERATIC-CLASSICAL & DANCE	BAND	POPULAR
TUESDAY	OPERATIC CLASSICAL & DANCE	POPULAR		BAND
WEDNESDAY	BAND		POPULAR	OPERATIC-CLASSICAL & DANCE
THURSDAY	POPULAR	BAND	OPERATIC-CLASSICAL & DANCE	
FRIDAY	VARIETY	VARIETY & DANCE	VARIETY	VARIETY
SATURDAY	VAUDEVILLE & DANCE	VAUDEVILLE & DANCE	VAUDEVILLE & DANCE	VAUDEVILLE & DANCE
SUNDAY	DIVINE SERVICE, FOLLOWED BY CONCERT			

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